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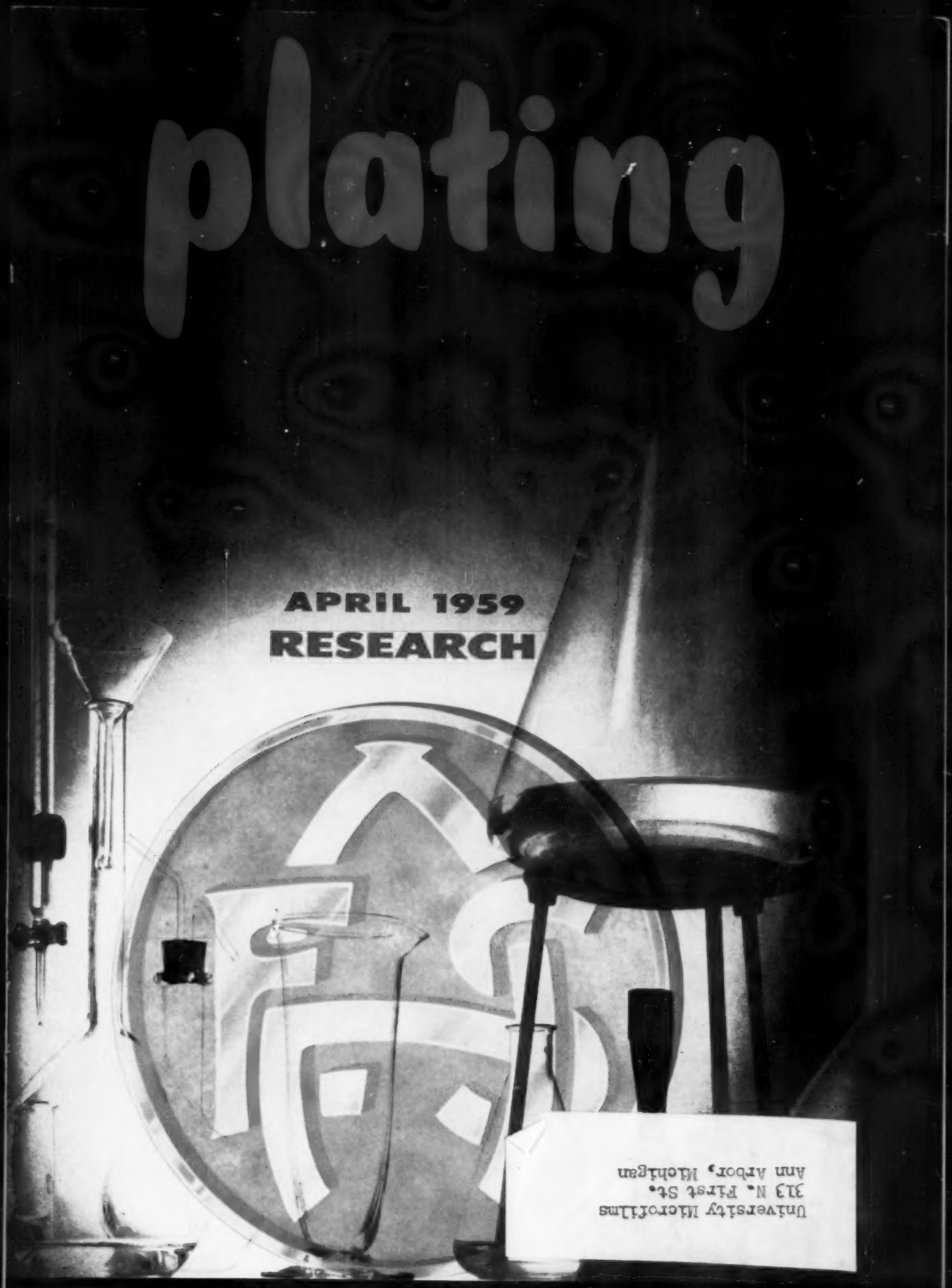

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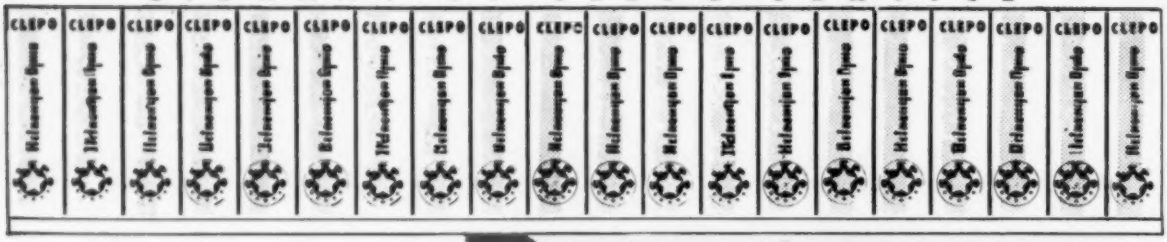

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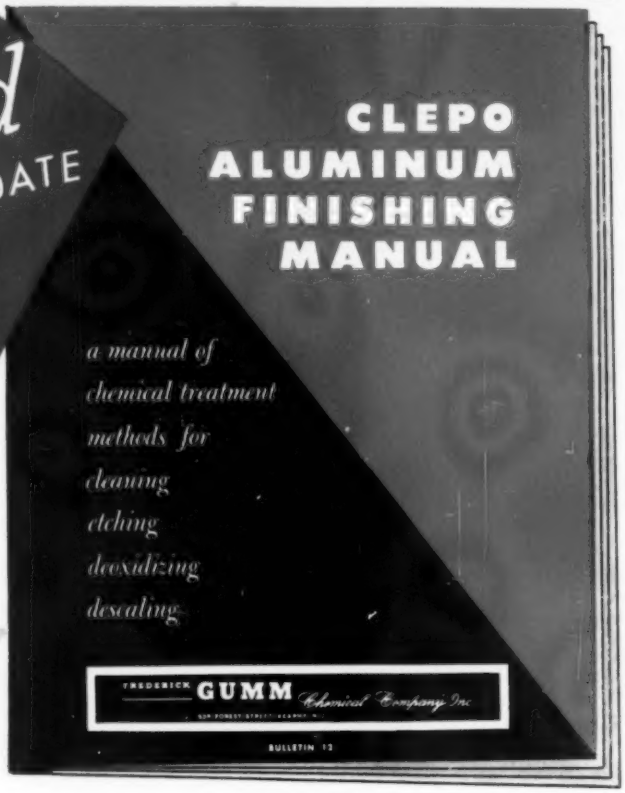

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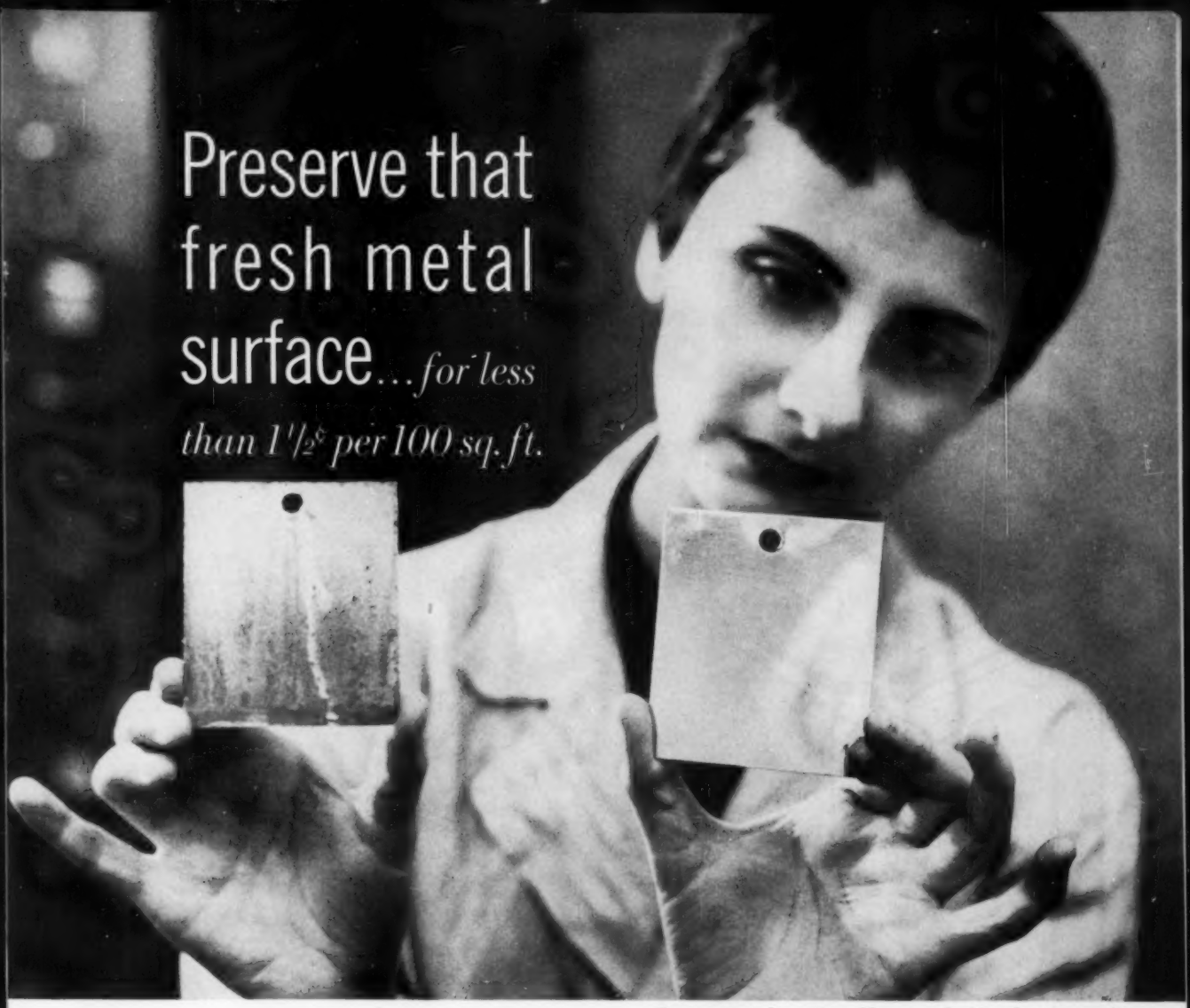

Compare treated vs untreated brass panels. After cleaning, panel on right was rinsed in Entek 45 rinse; panel on left, in standard hot water rinse. Then panels were exposed to 100% humidity at 100° F. for 100 hours. Note how Entek 45 preserves "that fresh metal surface."

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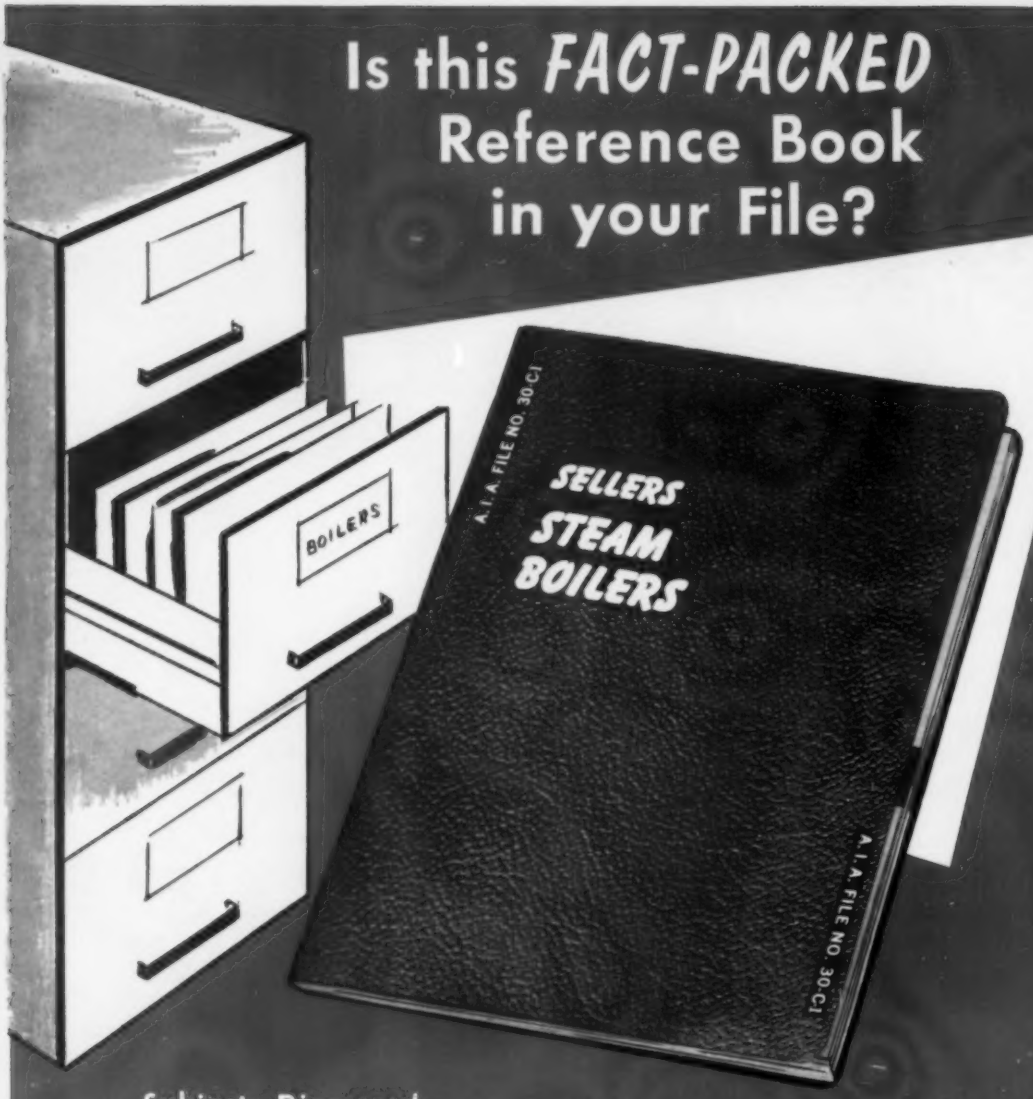

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JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

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Published by the American Electroplaters' Society, Incorporated, 445 Broad Street, Newark 2, N. J. Phone: HUmboldt 2-3400. Yearly subscription for Members $2.00. Nonmembers U. S. and Canada $5.00. 65c a copy. Foreign, $8.00 a year. $1.00 a copy.

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PLATING is indexed in Applied Science and Technology Index and abstracted regularly in Chemical Abstracts, Metals Review, Metallurgical Abstracts, Engineering Index, Technical Data Digest, and Bulletin Analytique.

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EDITORIAL

COOPERATION

NOT MANY OF US have the privilege of serving on the Research Committee. Certainly, it would be desirable from the standpoint of improved communications if more of our members could have this experience. However, this appears impractical due to the three-year term required to obtain a bare working knowledge of how this cooperative program functions.

Devoting much of an entire issue of PLATING MAGAZINE each year to the Research Program is an attempt to provide more information to the membership. This practice, which started with the May 1957 issue provides an overall picture of the scope and progress of the currently active Projects. Previous custom was to publish randomly the papers or complete progress reports throughout the year.

The AES Research Program is uniquely dependent upon cooperative effort. Starting, years ago, with a Research Fellow at the Bureau of Standards and financed by contributions from finishing industries, the Research Program is today mainly dependent on Sustaining Memberships. An additional source of income is the one dollar contribution from each AES member's dues. This latter source amounted to approximately $7,000 last year. Since the estimated budget for the current year was $47,000, our dependence on Sustaining Members is apparent.

The research work itself is dependent upon cooperative effort. Each Project has a Project Director, Project Committee and a District Supervisor, whose functions provide proper direction for the attainment of the Program's objective. This practice not only insures good guidance for each project, but also has side benefits in training new people for metal finishing research.

The AES Research Program can progress even further forward next year if you yourself will help, as an individual, to sign up at least one new Sustaining Member.

Russel E. Harr

Chairman
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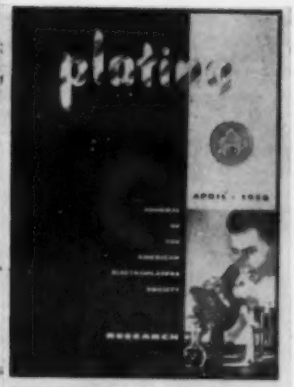

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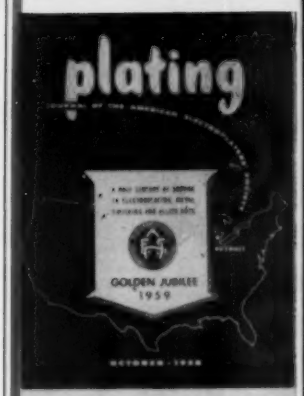

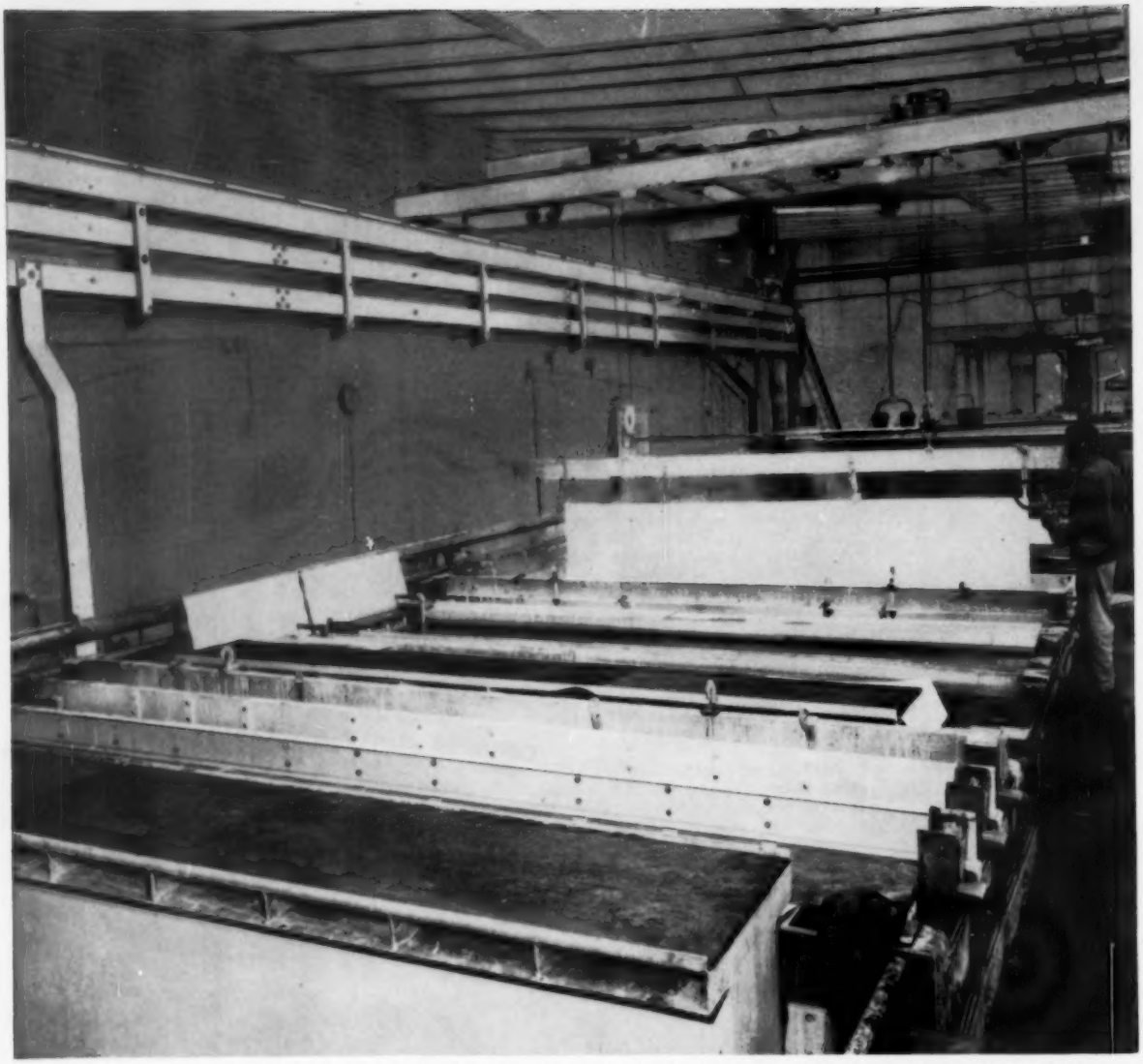

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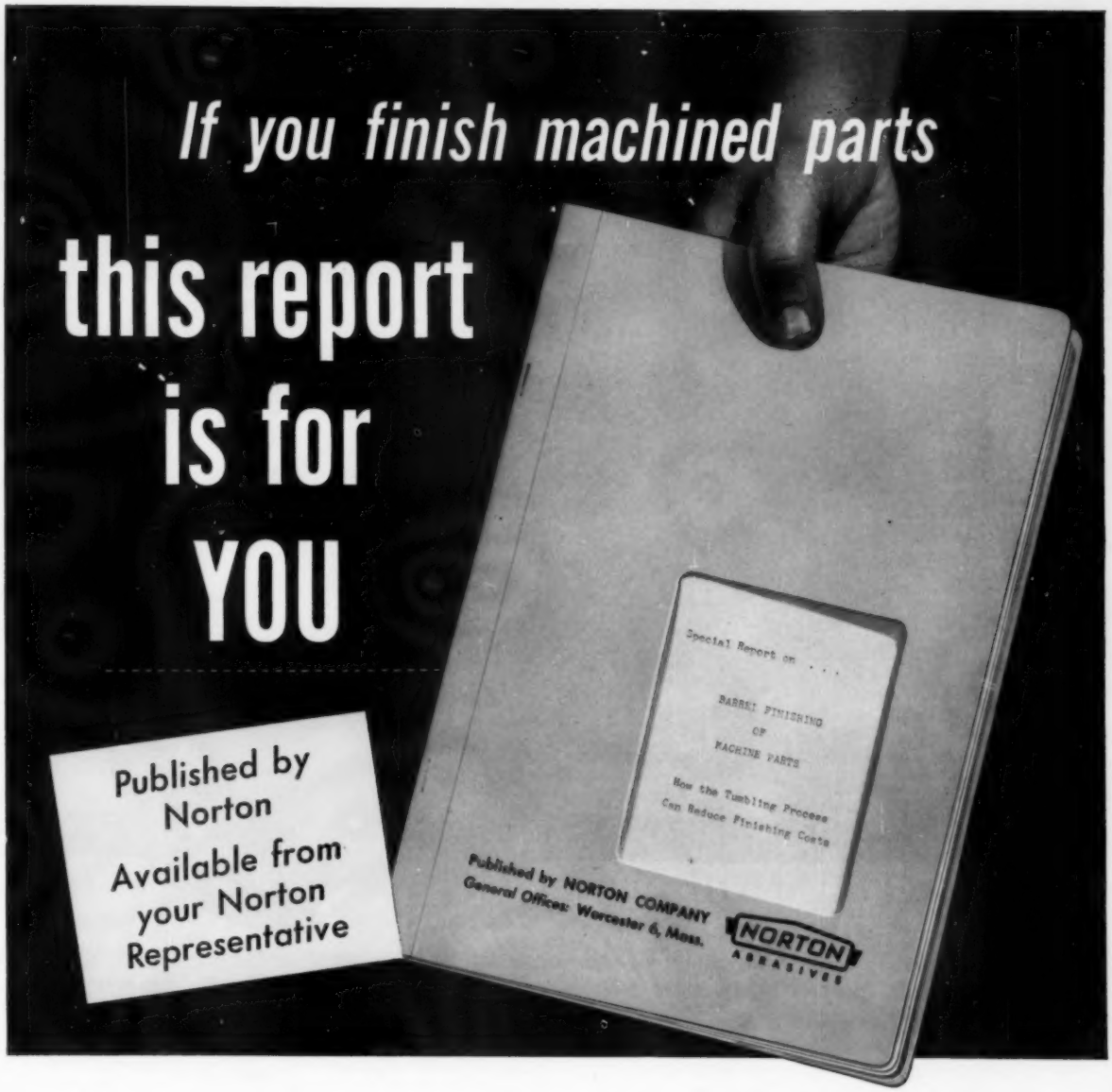

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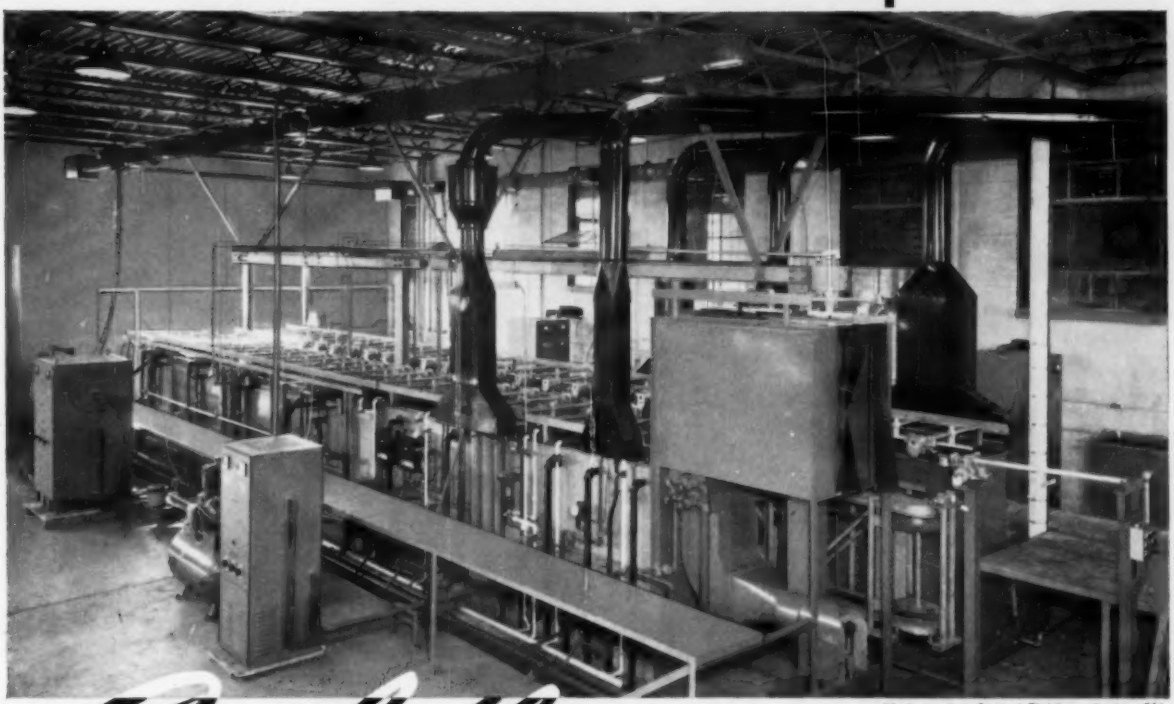

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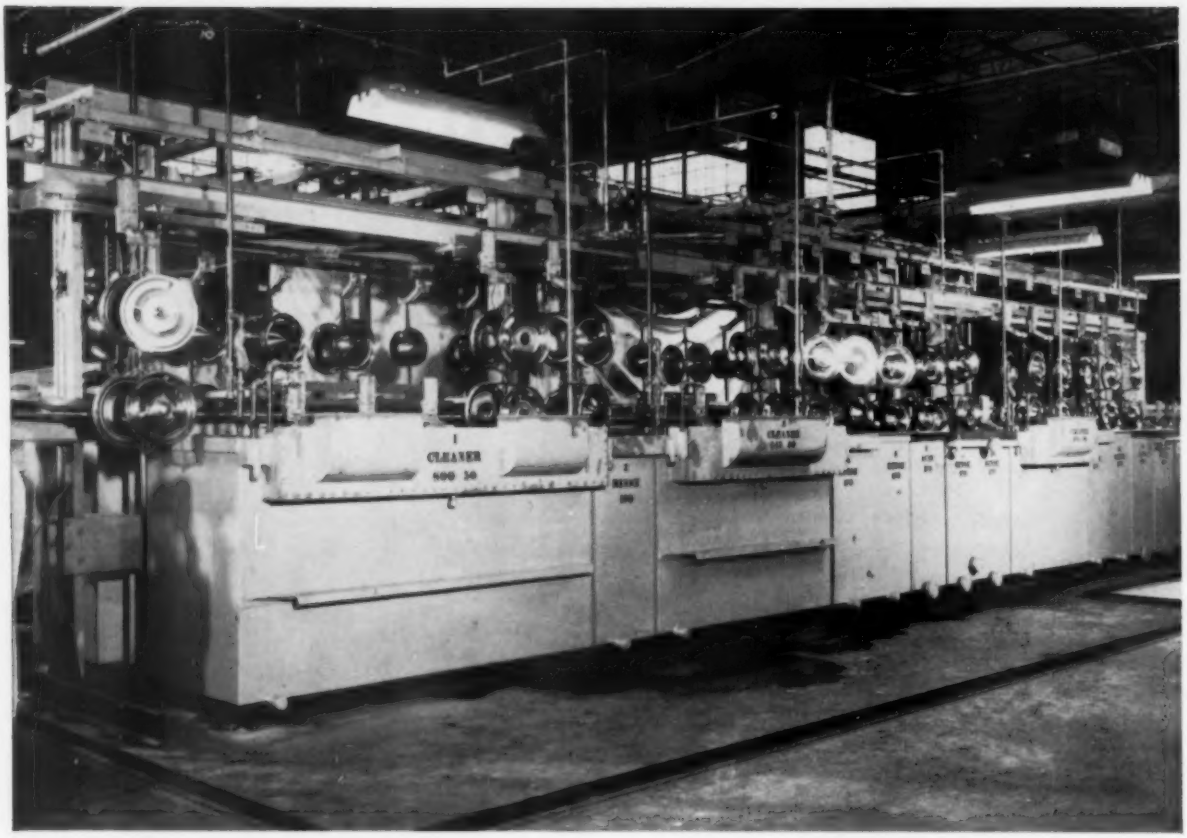

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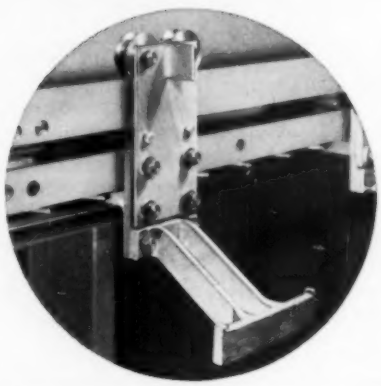

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write for New Bulletin U-658

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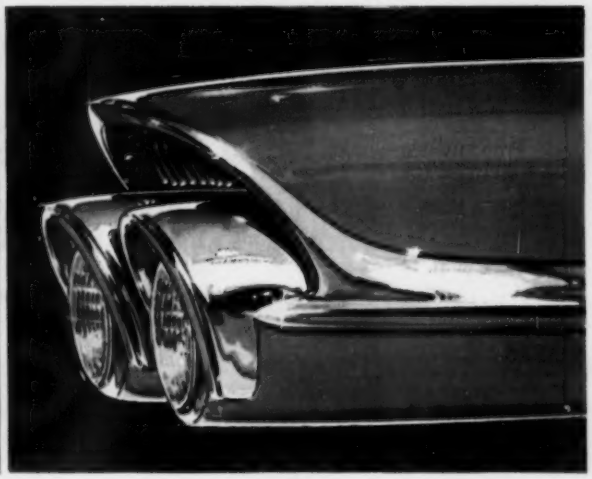
both finished by Acme machines!

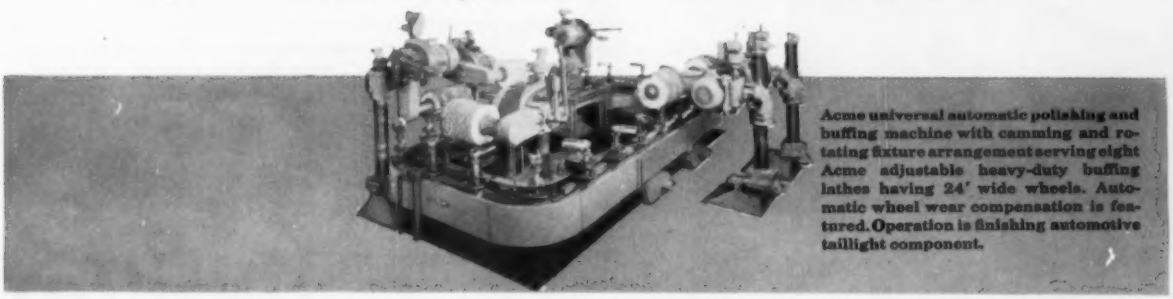


Even back in 1910, part of an owner's pride in his car lay in gleaming brightwork. But buffing and polishing the shiny metal that he loved so well caused manufacturers plenty of headaches. And so they turned to Acme—and Acme has continued to supply the answers to their finishing problems.

Today, Acme engineers combine standard units with a variety of accessories to make custom buffing and polishing machines. Large corporations and small job shops alike use Acme machines to reduce rejects, increase production volume, machine finish odd-shaped pieces.

Every year of its history, Acme has encountered new finishing requirements—each an individual problem—and solved them. Chances are, we can solve your problem, too. Send for illustrated 16-page catalog today.

50 years of *Polishing Off* your finishing problems



Acme universal automatic polishing and buffing machine with camming and rotating fixture arrangement serving eight Acme adjustable heavy-duty buffing lathes having 24' wide wheels. Automatic wheel wear compensation is featured. Operation is finishing automotive taillight component.

ACME MANUFACTURING COMPANY

1400 E. 9 MILE ROAD, DETROIT 20, MICHIGAN

LEADING PRODUCERS OF AUTOMATIC POLISHING AND BUFFING EQUIPMENT SINCE 1910

EMINENCE IN EQUIPMENT DESIGN · INFILCO · GIVES YOU PLUS VALUES ·

in water, sewage and waste treating equipment

NOW...INFILCO RESEARCH and DEVELOPMENT DIVISION EXPANDED

to give you more PLUS VALUES than ever

Recommendations for treatment are based upon water analyses and laboratory tests.

Precision components are thoroughly tested and calibrated.

Equipment is custom designed for your specific requirements.

A. A. Kalinske, Vice President and Technical Director in charge of Research and Development.

Continuous improvements in equipment and methods for

water softening and clarification —
sewage treatment —
pollution abatement —
valuable material recovery —

these have been the objectives of INFILCO for many years. The Research and Development Division has been expanded to accelerate new developments in water and waste treatment—and to work with you and your engineer for the solution of specific problems.

INFILCO INC.
General Offices — Tucson, Arizona
Field offices throughout the United States and in other countries

INFILCO

A Timely Message on Tenacity of the individual by Ben P. Sax

Chairman of the Board, *American Buff Company*

Dogged perseverance, backed by belief based on knowledge, has made a lot of little fellows rich, in the face of discouragement by the experts. One of the most recent illustrations is the triumph of a Kentucky farmer.

Knowing the terrain and the underlying oil supply, farmer Turner, a self-taught oil expert, persuaded a gas company to drill for oil in "a poor man's field" in easy reach of water-well equipment (and its comparatively small well cost). They struck oil. But, faced with high costs of separating it from the salt-water-and-oil mixture, they sold out in disgust to Turner, who had obtained the leases.

"Tenacious Turner" still believed it could be done — and easily — although geologists and oil experts had always insisted it could not be commercially economical. With powerful pumps, he drew down the water level fast, let the rock-trapped oil flow into the bore. In one day, Turner's method now produces as much oil as the company's efforts produced in an entire month.

The balance of the oil boom story: the poor farmers on poor land are now rich owners on easy street. Just one more example of the spark that led pioneers not only to settle and build our land, but also to develop the industrial marvels which keep our standards of living always on the rise.

Sincerely,

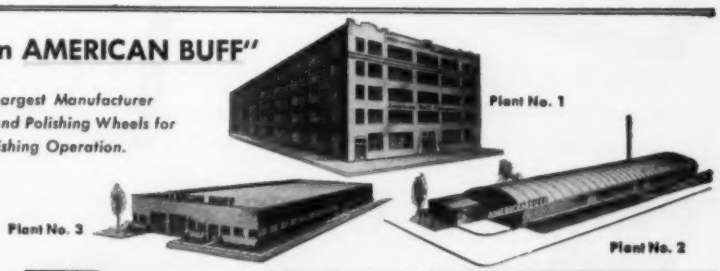
Ben P. Sax

"For the job that's TOUGH—use an AMERICAN BUFF"

BIAS CLOTH • BIAS SISAL • UNIT CLOTH OR SISAL

Patented CENTERLESS Construction
Pat. No. 2,582,506

World's Largest Manufacturer of Buffs and Polishing Wheels for Every Finishing Operation.



American Buff Company
2414 S. La Salle Street Chicago 16, Illinois

AMERICAN BUFFS ARE REGULARLY ADVERTISED IN FORTUNE MAGAZINE

remove RUST SCALE and SMUT FROM FERROUS METALS

with fast-acting AHCO Compounds

Whatever your removal problem, it will pay you to check Ahco's *complete* line of tested and proven compounds. Included are both acid and alkaline materials for soak tank, electrolytic tank, and tumbling operations. Three of the most popular are...

AHCO Deruster No. 11

A powerful, non-toxic alkaline compound, Ahco Deruster No. 11 will not attack ferrous base metal. It's ideal in electrolytic soak tanks.

AHCO Deruster No. 11-E

A non-ferrous alkaline compound for use in tumbling barrels, Ahco Deruster No. 11-E produces a clean bright surface.

AHCO Descaler A

A new, economical dry acid material, AHCO Descaler A is ideal for use in many acid dipping operations.

FREE bulletins describing these and many more AHCO Compounds are now available . . . write for your copies to

Hubbard Hall

APOTHECARIES HALL CO.

DIVISION OF

THE HUBBARD-HALL CHEMICAL CO.

WATERBURY, CONN.

It takes both know-how and quality chromic acid to produce quality plating...

that's why

MUTUAL

tests every drum...

The uniform, high quality of Mutual Chromic Acid – that teams with the plater's skill to produce premium plating results – is insured by our testing the contents of *every* drum before shipment.

When you order Mutual Chromic Acid, you know the product you get is always 99.75% pure – or better. Sulfate content never exceeds 0.1% to permit more accurate control of the acid-sulfate ratio in the bath.

A booklet "Mutual Chromium Chemicals," contains technical information on chromic acid and our entire line of Mutual products.

Mutual chromium chemicals

Sodium Bichromate
Sodium Chromate
Chromic Acid
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Potassium Chromate
Ammonium Bichromate
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SOLVAY PROCESS DIVISION
61 Broadway, New York 6, N. Y.

Allied Chemical

MUTUAL chromium chemicals are available through dealers and SOLVAY branch offices located in major centers from coast to coast.

Solvay Process Division
Allied Chemical Corporation
61 Broadway, New York 6, N. Y. Dept. 8-4

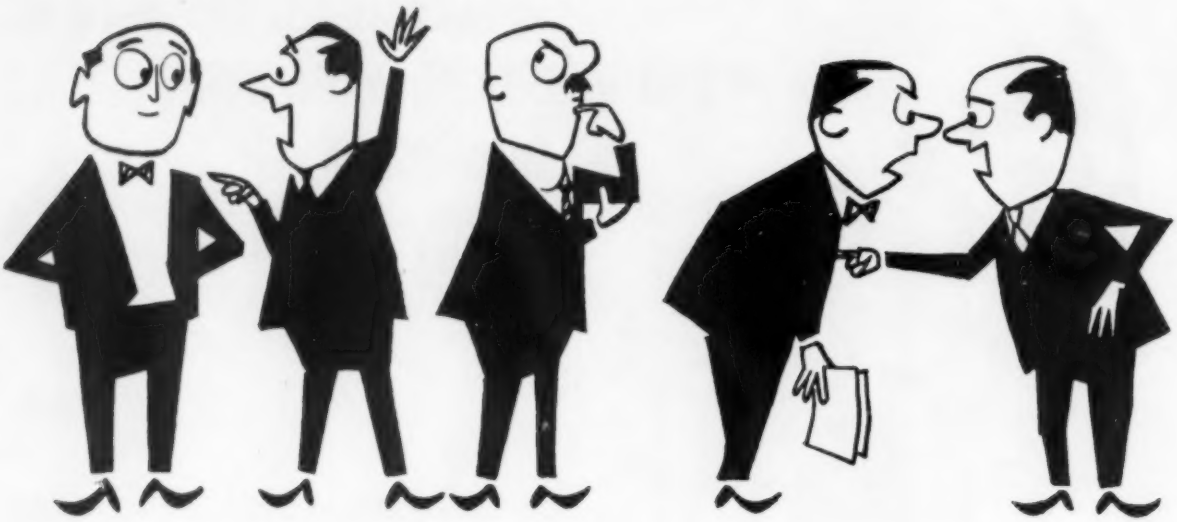
Please send me Bulletin #52—"Chromium Chemicals."

NAME_____ TITLE_____

COMPANY_____

STREET_____

CITY_____ ZONE____ STATE_____



TROUBLE . . . in Tank No. 5!

Rejects are high and the customer is getting nervous. Trouble is, these platers have overlooked calling in ROHCO®. While we market an A to Z line of plating specialties—from Automatics to Zinc Brighteners—we go much further than that in customer service. Our experienced and highly skilled laboratory technicians take pride in our most important product—"plating know how". If there is an answer to a problem—from miniature test tanks to huge automatic plating installations—it will pay you to look for guidance from one qualified and reliable source—ROHCO.

Our service representatives and stockpoints are centrally located in fourteen cities in the U.S.A. and in Toronto, Canada. Your inquiry is most welcome.

ZINC BRIGHTENERS

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XL CADMIUM BRIGHTENERS

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CHROMATE CONVERSION COATINGS

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AND OTHER SPECIAL PURPOSE PRODUCTS FOR PLATING

ROHCO

Nationwide Stockpoints

R. O. HULL & COMPANY, INC.

1302 Parsons Court Rocky River 16, Ohio

THE RIGHT START . . . A BETTER FINISH

GRAVER REPORTS ON RESEARCH AND DEVELOPMENT

Here are the Latest Results

...of an intensive program of chemical research and engineering development carried on by Graver Water Conditioning Co. with a twofold purpose:

- to advance the art and science of liquid treatment
- to solve practical problems as they arise on individual jobs

Graver has made, and continues to make, studies of all aspects of equipment design, operating results and process techniques with the view to improving existing methods and developing new ones for the treatment of all types of liquids.

As new achievements are realized through this constant search, they are given practical form and made available for the benefit of the fields served by Graver: *power plant utilities, industrial and municipal water treatment, industrial waste treatment and chemical processing.* The products shown on this page are but a few of the recent developments from Graver's expanding facilities, now the largest in the liquid treatment industry.

OTHER GRAVER ACHIEVEMENTS

Iron and Copper Scavengers • Automation, Instrumentation and Control • Techniques for Prevention of Resin Fouling The Reactivator® • Spherical Ion Exchange Units Rota-Rake® Clarifiers and Thickeners Subfill-less Underdrain Designs • Shericone® Hot Process Sedimentation Units Increase of Ion Exchange Applications • Flotation Units Parabolic Plug Spray Valves • Sub-Surface Washers

Write for Detailed Literature, Dept. R

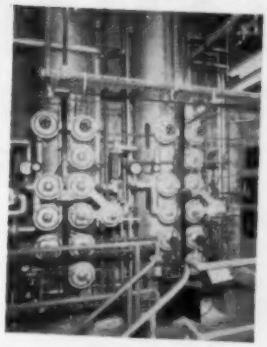
GRAVER

GRAVER WATER CONDITIONING CO.
Division of Union Tank Car Company
216 WEST 14th STREET, NEW YORK 11, N.Y.

IN CANADA: GRAVER WATER CONDITIONING CO.
Division of Products Tank Line of Canada, Ltd.
268 CHURCH STREET, MIMICO,
TORONTO 14, ONTARIO

INDICATE A 418.

GRAVER WATER CONDITIONING CO.
RESEARCH AND DEVELOPMENT SECTION



REPORT NO: 197

Condensate Scavengers-for power plant utilities. Equipment for internal self-purification of condensate in sub-critical as well as supercritical boiler cycles.

GRAVER WATER CONDITIONING CO.
RESEARCH AND DEVELOPMENT SECTION

REPORT NO: 204

Dialysis Systems and Laboratory Units—for chemical processing and industrial waste treatment. Systems for separation of acid, alkali, neutral salt liquors.

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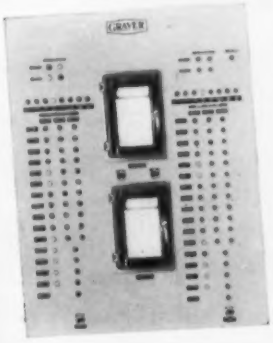
REPORT NO: 193

Non-Corrosive Underdrain — for municipal water treatment. New underdrain for gravity filters weighs much less than other designs and improves backwashing.

GRAVER WATER CONDITIONING CO.
RESEARCH AND DEVELOPMENT SECTION



REPORT NO: 187

Monitoring Systems — for all fields. Systems to check and report malfunction in the operation of demineralization plants, especially of the automatic type.

RELIANCE BARRELS

FOR BALL BURNISHING OR ABRASIVE TUMBLING

will give you better finishes faster

Type L

Rigid box-type construction
Heavy roller bearings
Quick-change door with safety valves
Gearhead motor and gear drive—no belts

Cylinder can be operated in horizontal and/or angle position which produces a double tumbling action; resulting in a better finish in shorter time.

Furnished with cylinder unlined; wood lined; or rubber lined. Available in two sizes.

TYPE A—TILTING TYPE

Easy to Load and Unload . . .
Round or Hexagon (oblique) Shaped Tubs . . .
With or without Vulcanized Rubber Lining . . .
Gearhead Motor . . .
Low Maintenance Cost

HANDLES WIDE VARIETY OF SHAPES AND LOADS

Type A

Type G

A heavy duty barrel for large production ball burnishing or abrasive tumbling. Available in many capacity ratings.

Lined with hardwood or heavy vulcanized rubber.

Our 60th Year

Send for complete circular on Burnishing Barrels and Tumbling Media

Chas. F. L'Hommedieu & Sons Co.

MANUFACTURERS OF METAL FINISHING EQUIPMENT AND SUPPLIES

GENERAL OFFICE AND FACTORY

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Detroit, Mich.

ANOTHER NORTHWEST FIRST!

a completely NEW concept in metal cleaning!

- An easy handling liquid.
- Effective on *all* metals.
- Requires NO special tanks or equipment.
- A completely organic product.
- Won't injure rack coatings or work finish.
- Simple positive control.

Alkalume LC-1 is a specially developed immersion-type cleaner for removal of buffing compounds and soil from all metals, prior to plating or anodizing.

It is non-solvent, non-alkaline and not an emulsion. It has the desirable penetrating properties of both alkali and solvent yet affords complete protection for the surface finish.

Alkalume LC-1 is economical, non-toxic and non-volatile, offering long service life and no disposal problem.

Complete details upon request.

The name NORTHWEST means first with the best!

LO HI pH

NORTHWEST CHEMICAL CO.

9310 ROSELAWN DETROIT 4, MICH.

ALL-PURPOSE "CYANOBRIK" is shipped in full-open-head drums and is made in the form of 1-ounce pillow-shaped briquettes, convenient for measuring small quantities. Dusting is minimized, and accidental spillage can be cleaned up quickly and safely. It can be used in all sodium cyanide applications...including case hardening.

This is all-purpose "Cyanobrik" sodium cyanide.

Du Pont announces...

All-purpose Cyanobrik® —two convenient forms

All-purpose "Cyanobrik" in briquette form can be used in all sodium cyanide applications—including case hardening

JUST A TWIST OF A WRENCH unlocks the full-open-head drums used to ship all-purpose "Cyanobrik" and new "Cyanogran" M. Drums can be easily reclosed to provide full protection for unused contents.

Now you can use all-purpose "Cyanobrik" efficiently in *all* known applications for sodium cyanide, including plating, case hardening and chemical manufacture. The reason—a new manufacturing process at Du Pont's modern Memphis, Tenn., plant has succeeded in making "Cyanobrik" lower in moisture content and more resistant to moisture than ever before.

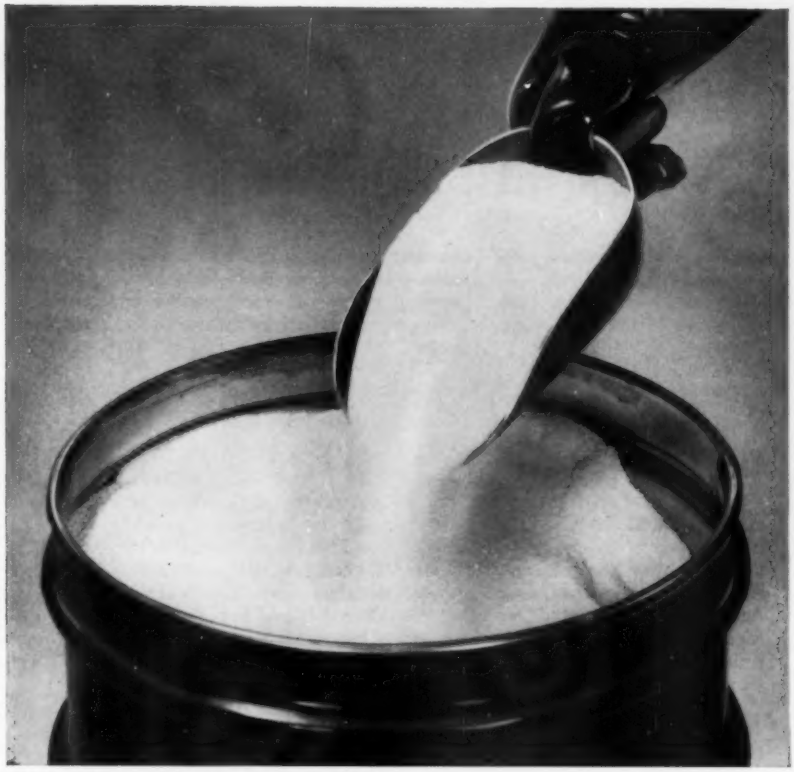
All-purpose "Cyanobrik" is guaranteed 97% minimum sodium cyanide. Maximum impurities are held so low you get an *extra pound* of active cyanide in every 100 lbs. you buy. And because it can be used in *all* applications, all-purpose "Cyanobrik" can help *you hold inventories down, simplify your purchasing.* Look at these high-quality specifications:

NaCN—97% min.; NaCl—0.2% max.; Sulfides as S—0.0005% max.

For more information just give your local Du Pont Distributor

DISTRICT AND SALES OFFICES:

Baltimore 2.....321 Fallsway
Boston 10.....140 Federal St.
Charlotte 1.....427 W. Fourth St.
Chicago 46. 7250 N. Cicero Ave., Lincolnwood
Cincinnati 2.....2412 Carew Tower
Cleveland 20.....11900 Shaker Blvd.



This is "Cyanogran" M sodium cyanide.

EASY-TO-DISSOLVE "CYANOGRAN" M has the same high purity of all-purpose "Cyanobrik"—97% minimum sodium cyanide. It passes through a 10 mesh screen, but not a 50 mesh screen . . . is easy to handle because fines and dusting are eliminated. "Cyanogran" M is also shipped in full-open-head drums.

and new Cyanogran® M of sodium cyanide 97%

New "Cyanogran" M, a granular easy-to-dissolve form of all-purpose "Cyanobrik" sodium cyanide—at no extra cost!

"Cyanogran" M was developed by Du Pont specifically for dry compounders who require a uniform particle size and for those who desire sodium cyanide in a more rapidly soluble form. It is controlled in size during manufacture so that it will pass 100% through a 10 mesh screen and will be retained by a 50 mesh screen. Result: "Cyanogran" M is easy to handle due to absence of fines and dusting.

"Cyanogran" M and all-purpose "Cyanobrik" are sold at the same low price. Both are made at Du Pont's modern Memphis, Tenn., plant—a reliable domestic source of supply for you. Du Pont and its conveniently located distributors assure you prompt delivery. Here are the specifications for "Cyanogran" M:

NaCN—97% min.; NaCl—0.2% max.; Sulfides as S—0.0005% max.

a call, or write your nearest Du Pont District Office listed below.

TECHNICAL HELP FOR YOU
Du Pont's experts are always ready to provide on-the-spot service. They're backed by the facilities of Du Pont's new 2-million-dollar sales-service laboratory to help solve *your* problem.

E. I. du Pont de Nemours & Co. (Inc.)
Electrochemicals Department
Sodium Products Division
Wilmington 98, Delaware

DU PONT
REG. U.S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

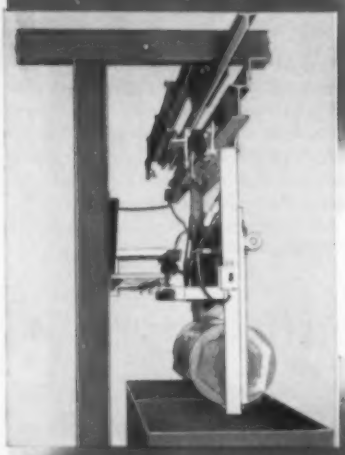
Detroit 35.....13000 W. Seven Mile Rd.
Kansas City 20*.....Guinotte & Mich. Ave.
Los Angeles.....Box 70, El Monte, Calif.
New York 1.....350 Fifth Ave.
Phila.....308 E. Lancaster Ave., Wynnewood
San Francisco 4.....111 Sutter St.
Export Division, Du Pont Building, Wilmington 98, Delaware *Barada & Page, Inc.

ALL NEW FROM **UDYLITE**

Fitted to a broad range of plating requirements

Variable with a wide range of operation, permitting adjustable down-dwell, up-dwell, delayed set-down, advanced lift-up or skip. The VIP allows variations to meet almost any need.

Integrated in a single combination of electric motor, self locking speed-reducer and an overrunning clutch with each cylinder and carriage assembly, forms a fully automatic, self-contained unit.

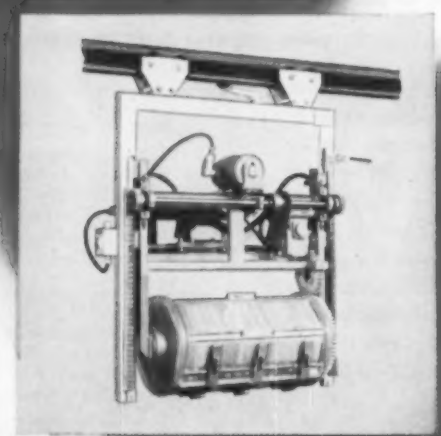


Side view of the VIP shows complete accessibility of all working parts and allowance for easy servicing of the tanks. There is ample room for adequate ventilation from both sides of the tank.

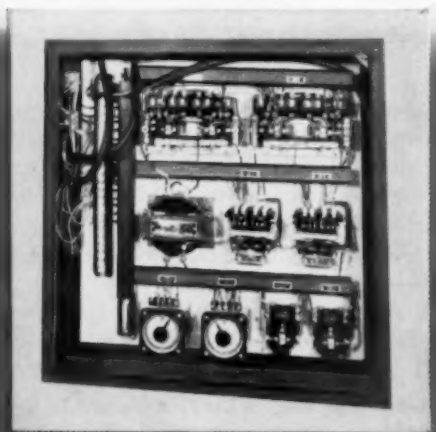
In the VIP, Udylite provides a machine combining efficiency, flexibility and fully automatic control for all metal finishing processes. At last, the VIP makes available to the industry a machine affording a truly progressive innovation. Pairing automatic controls with mechanical operation, the VIP consistently produces the highest quality work at the lowest possible cost. The VIP is a machine of 1000 uses, delivering job after job and lot after lot to meet the specifications precisely. Control is easier, quality more uniform, and efficiency higher when you put Udylite's VIP to work in your plant.

Even with high volume production, quality control is maintained with economy. For instance, the VIP may be arranged so that transfers through the processing cycle occur at frequencies two, three or four times that of the plating cycle. This eliminates the need for carriage and cylinder assemblies at every machine station but does not affect production because the plating tank will be filled with cylinders at all times. Barrel units, however, may be added as required by production or cycle changes. This innovation makes it profitable to process comparatively low volumes of work automatically on the VIP. Standard cylinders are furnished in two sizes—14″ x 30″, 14″ x 36″*. Cylinders are set to revolve at a standard 6 rpm, but this rate may be varied by simply changing the vee belt drive. Intermittent rotation is provided for cylinders after di-chromate dips to prevent undue nicking of the chromate film.

*14″ x 24″ & 14″ x 42″ cylinders available on special order.



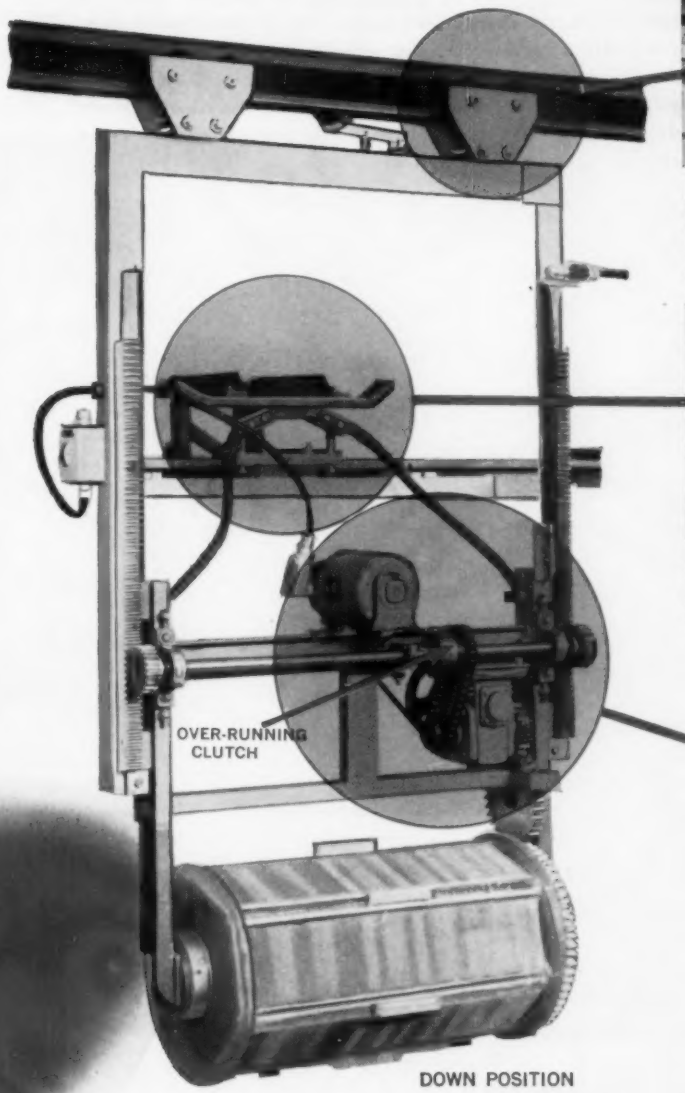
Up Position of VIP. Any number of barrels may be left in the up position indefinitely. For trial runs the machine can be set so that only one barrel goes through processing.



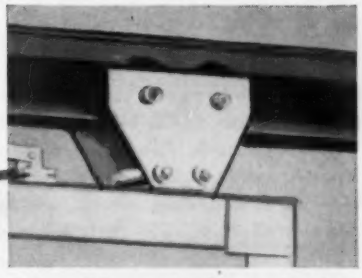
Individual station control. Immediate control is maintained over operations from this single center. Adjustable timers for delayed dips, drag-outs, and down-dwells are located at this one central point.

THE VIP* CONVEYOR

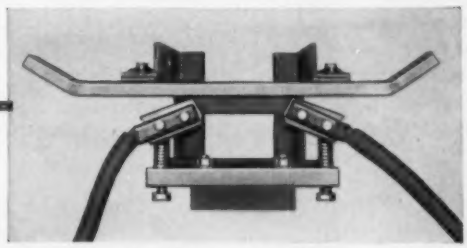
Processing work in barrels, oscillating trays or perforated boxes is fully performed in such operations as cleaning, rinsing, pickling, plating, phosphating and other similar treatments.



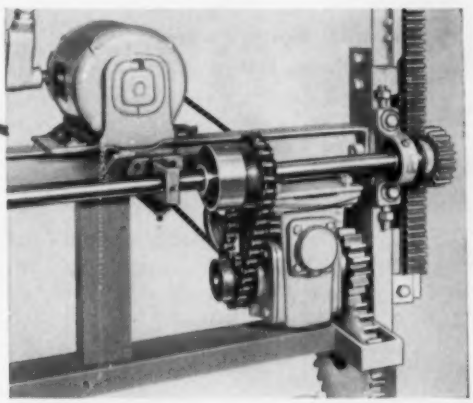
DOWN POSITION



Monorail Suspension System. Standard I-beam type monorail is furnished on all VIP-type systems. Barrels are transferred by a positive pusher-type indexing system.



Extra heavy bussing on the VIP. The machine is bussed for 1000 amperes per station. This far exceeds normal demands. Positive, self cleaning contacts are used.



Single Operating Motor. Each cylinder and carriage assembly has an individual electric motor which both rotates the cylinder and raises it for transfer. In the "down position" the cylinder revolves freely. When the motor is reversed, an over-running clutch grips the shaft to elevate the barrel.

REGARDLESS OF THE AMOUNT OF PRODUCTION YOU HANDLE, IT WILL PAY YOU TO INVESTIGATE THE **VIP.** CONSULT THE YELLOW PAGES FOR THE NEAREST UDYLITE REPRESENTATIVE OR WRITE DIRECT...

the **udylite** corporation

detroit 11, michigan → world's largest plating supplier

GOLDEN JUBILEE ISSUE ADVERTISING RESERVATION

THE Fiftieth Anniversary observance of the American Electroplaters' Society, Inc. (AES) will be climaxed not only by the AES's Golden Jubilee Convention and Industrial Finishing Exposition, including the Fifth International Conference on Electrodeposition and Metal Finishing, to be held in Detroit, June 15-19, 1959 but also by the GOLDEN JUBILEE ISSUE of AES's PLATING MAGAZINE (June 1959).

A FEATURE edition beamed to command global readership appeal by the character of its special technical and scientific articles, it will also have rare remembrance strength and long retainment as an AES reference source and memento of AES's GOLDEN ANNIVERSARY by the character of its institutional and historical contents, including the "Kaleidoscope of AES's First Half-Century."

BECAUSE of the GOLDEN JUBILEE ISSUE's planned sizable editorial stature, PLATING's current plans for that issue allow for a fixed number of pages of company product and institutional advertising, much of which has already been spoken for by PLATING MAGAZINE's regular contract advertisers. There is no price increase for advertising in that issue. PLATING's current space rates (Rate Card No. 9), lowest among magazines in this field for largest paid circulation apply to wit on a one-time basis:

1 page.....$270	1/2 page.....$155
2/3 page..... 250	1/3 page..... 150
1/2 page (Is).... 220	1/4 page..... 80
1/8 page..... $60	

Extra charge for color and/or bleed.

Available special positions are charged extra.

ALL text and plates for advertising accepted and contracted to appear in the GOLDEN JUBILEE ISSUE must be in the hands of PLATING's Production Manager on or before April 15, 1959, except by agreed extension.

IF YOU are among the many companies interested in reaching the vast purchasing power of the electroplating and metal finishing industry through product or institutional advertisement(s) in this unique feature edition, you are earnestly invited and urged to fill out the below advertising reservation ticket, and mail it NOW to Golden Jubilee Issue Section, PLATING MAGAZINE, 443-445 Broad Street, Newark 2, N. J.

GOLDEN JUBILEE ISSUE ADVERTISING RESERVATION

Golden Jubilee Issue Section
PLATING MAGAZINE
443-445 Broad Street
Newark 2, N. J.

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Reserve for .... (Specify Company)

a total of .... (Specify amount of space) in the GOLDEN JUBILEE ISSUE and communicate by phone or letter with the undersigned so as to finalize insertion details.

.... (Company or Agency)

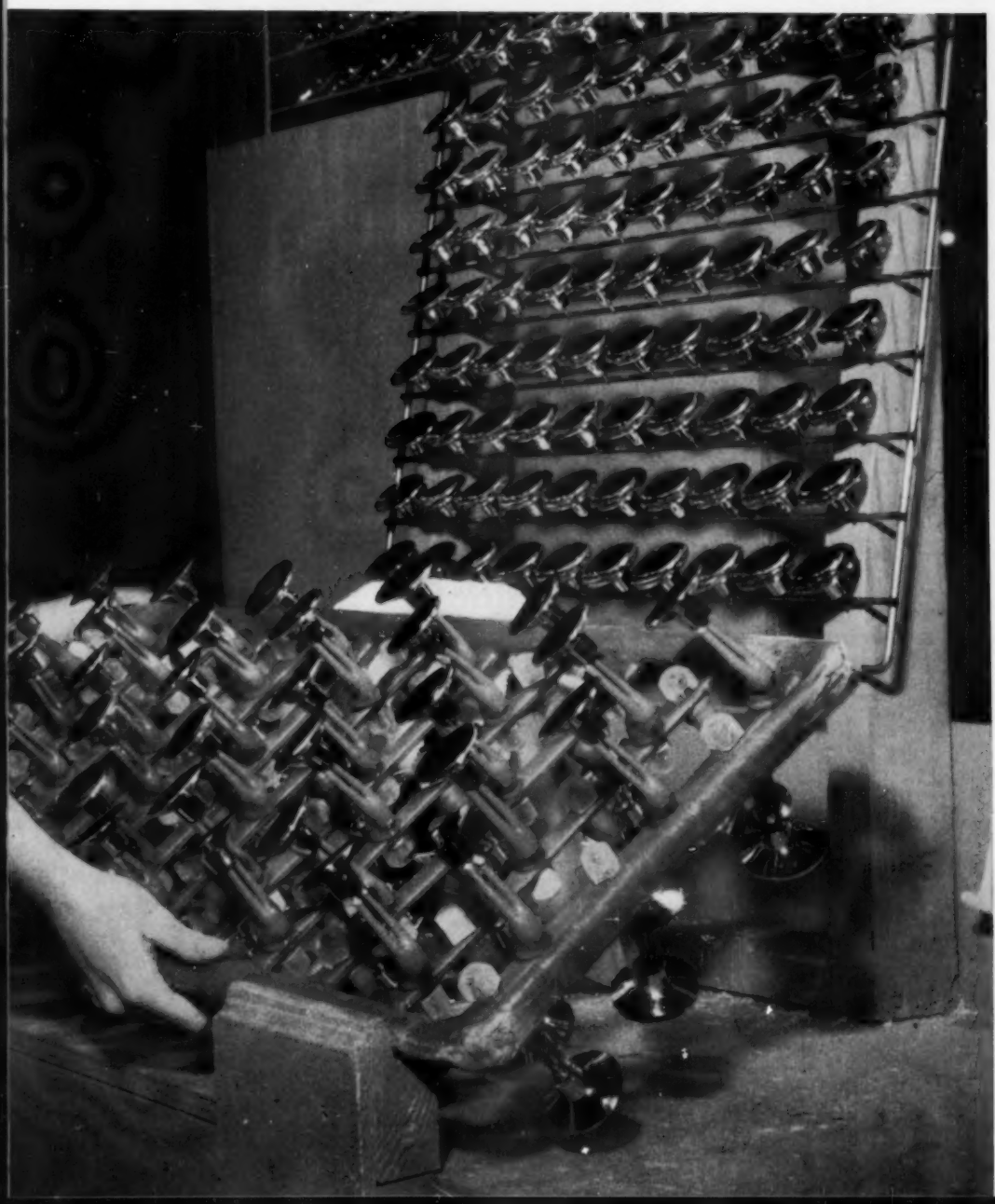
By .... (Title)

A-1

INDICATE A 423.➤

Unique new brightener for zinc and cadmium plated parts has been developed by Federated: CONMAX, a conversion coating for plated finishes from brilliant to iridescent, provides corrosion resistant film to zinc and cadmium plate. Other high quality, low-cost brighteners from Federated: ZIMAX for all types of zinc plating, still, automatic, and barrel; CADMAX for cadmium plating; NIMAX, highly concentrated brightener for nickel barrel plating. These brighteners undergo rigid competitive tests before approval for sale. This also applies to Federated's complete line of plating anodes and nickel salts. It's safest when you specify plating supplies from Federated Metals Division of American Smelting and Refining Company, 120 Broadway, New York 5, N. Y. In Canada, Federated Metals Canada, Ltd., Toronto and Montreal.

FEDERATED METALS DIVISION OF



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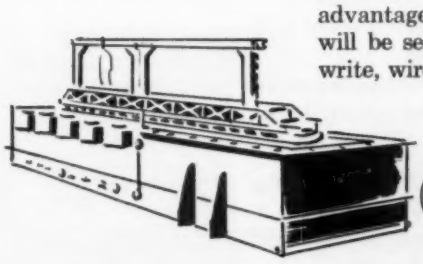

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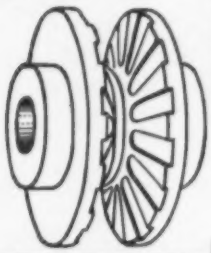

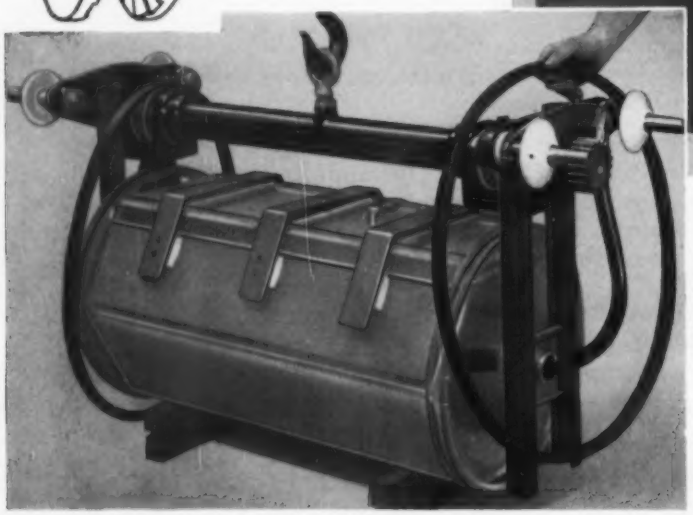

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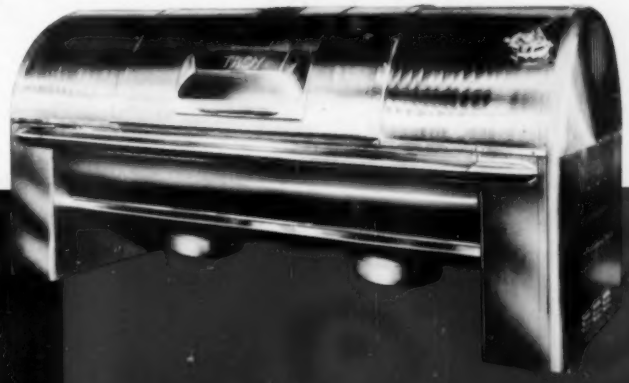
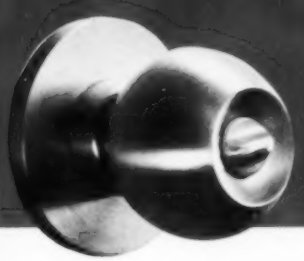
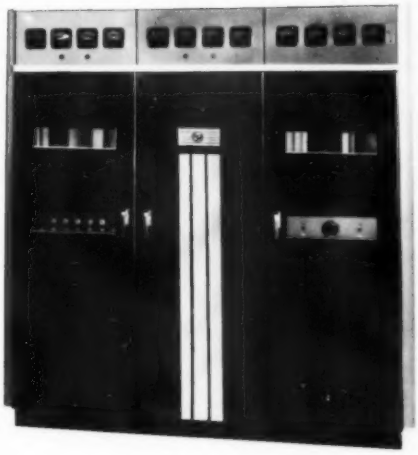


LEA

SATIN FINISH





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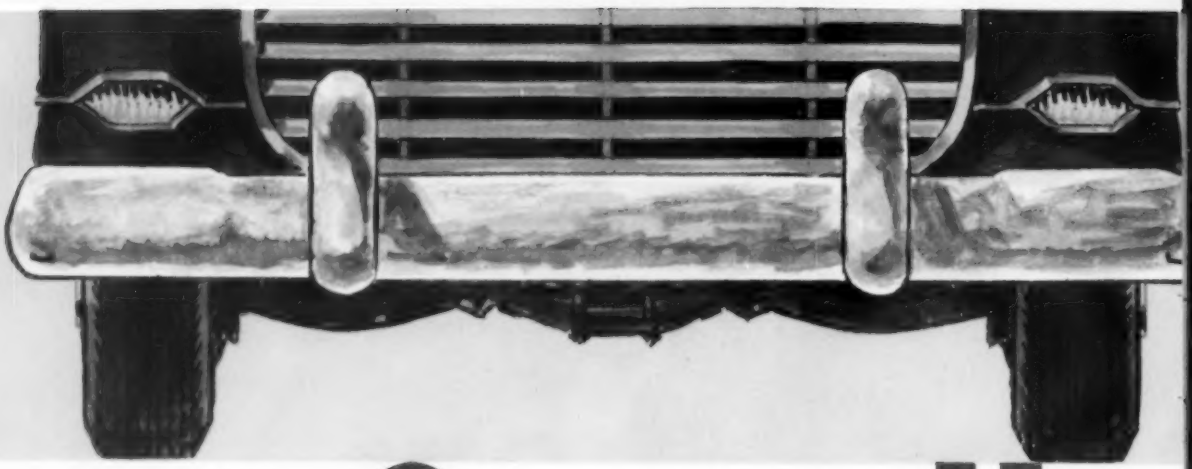

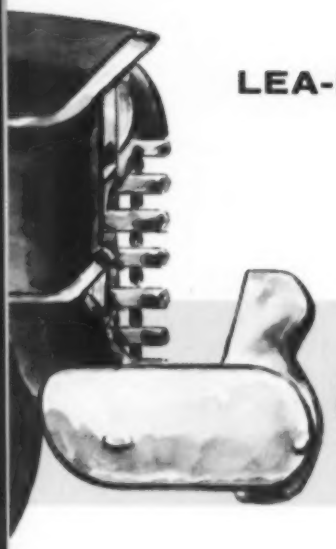

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AES RESEARCH IN GOLDEN JUBILEE

Leland M. Morse
Member

OUR NATION's industrial economy stands as a testimonial to the power of research, and as a tribute to the business leaders who regard research as an investment rather than an expense. No greater catastrophe can befall a business than newer and more effective methods or materials in the hands of a progressive competitor.

Many aspects of plating and metal finishing are too complex to permit any company to bear the expense of full research alone. The cooperative research program of the American Electroplaters' Society, Inc. is tailored, therefore, to benefit individual companies by enriching technical and scientific knowledge in electroplating, metal finishing and allied arts through broad and directly useful fact-finding on a shoulder-to-shoulder basis.

This program, developed over a long span of years, embodies research projects sponsored by the AES at a number of American and Canadian universities and foundations pinpointed to specific improvements sought in electroplating, metal finishing and allied arts.

The program is financed by the AES not only by allocation thereto of a share of the annual membership fees of its Active Members and Members-at-Large but also by the Sustaining Memberships financed by a substantial number of American and Canadian industrial companies.

Concerted action now in progress through AES Research is providing the industry with more technical muscle NOW. Effectiveness of the program is derived from wide participation. Though program direction resides in the Society's Research Committee, each project comes under the jurisdiction of a District Supervisor who, in turn, works with individual groups of experts termed Project Directing Subcommittees.

These positions are appointive thus harnessing specialized backgrounds to technical subjects under investigation. Accordingly, many qualified people from industry, government and technical agencies are contributing talents, without remuneration, so that the results of AES Research will be of maximum industry wide utility.

Each project is established with a Director who is on the scene in immediate charge of the work at a university or foundation on a day-to-day basis, the research itself normally being carried out by one or more Research Fellows. Only these Directors and Fellows are compensated for their services.

The results of AES Research over a span of some two decades were summarized in PLATING's May 1957 and April 1958 issues. The following highlights developments during 1958–1959, AES's Golden Jubilee Year.

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Raymond L. Mitchell
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Glade P. Bowman
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Clyde Kelly
District Supervisor

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Cleveland F. Nixon
District Supervisor

Clarence H. Sample
District Supervisor

INDICATE B 402.➤

AES RESEARCH PROJECTS: FROM BIRTH TO DATE

PROGRAM'S PHASE NO. 1. (1929-1944)

The Spotting of Plated or Finished Metals—National Bureau of Standards—(Concluded 1929)

Throwing Power in Chromium Plating—National Bureau of Standards—(Concluded 1929)

The Porosity of Electroplated Chromium Coatings—National Bureau of Standards—(Concluded 1931)

Protective Value of Nickel and Chromium Plating on Steel—National Bureau of Standards—(Concluded 1934)

Accelerated Tests of Nickel and Chromium Plating on Steel—National Bureau of Standards—(Concluded 1934)

Corrosion-Protective Value of Electrodeposited Zinc and Cadmium Coatings on Steel—National Bureau of Standards—(Concluded 1935)

Outdoor Exposure Tests of Electroplated Nickel and Chromium Coatings on Steel and Nonferrous Metals—National Bureau of Standards—(Concluded 1940)

Methods of Polishing Steel and Their Effects Upon the Protective Value of Electroplated Coatings—(Concluded 1944)

PROGRAM'S PHASE NO. 2. (1944-1959)

Project No. 1. "Stripping of Copper from Various Base Metals," Indiana University (1945–1947) Last phase conducted at National Bureau of Standards

Project No. 2. "Determination of Impurities and Major Constituents in Electroplating Solutions and Analysis of Cyanides in Plating Room Wastes," Lehigh University and Princeton University (1944–1955)

Project No. 3. "Adhesion of Electrodeposits," University of Michigan (1945–1947)

Project No. 4. "The Effect of Surface Finishing of Nonferrous Base Metals on the Protective Value of Plated Coatings," U. S. Time Corporation (1947–1954)

Project No. 5. "The Effect of Impurities and Purification of Nickel Plating Solutions," Michigan State University (1945–1957)

Project No. 6. "Porosity of Electrodeposited Metals," Princeton University (1946–1954)

Project No. 7. "Methods of Testing Thickness of Electrodeposits," Pennsylvania State University (1945–1951)

Project No. 8. "Polarization and Overvoltage," Cleveland Graphite Bronze Co., Division of Clevite Corp. (1946–1952)

Project No. 9. "Physical Properties of Electrodeposited Metals—Nickel," National Bureau of Standards (1947–1952)

Project No. 10. "Disposal of Plating Room Wastes," Yale University (1955–1957)

Project No. 11. "Current and Metal Distribution in Electrodeposition," Evansville College (1948–1952)

Project No. 12. "Cleaning and Preparation of Metals for Electroplating," Columbia University—Current (1948–To Date)

Project No. 13. "The Nature, Cause and Effect of the Porosity in Electrodeposits," National Bureau of Standards—Current (1950–To Date)

Project No. 14. "The Influence of Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating," Ontario Research Foundation—Current (1951–To Date)

Project No. 15. "Accelerated Corrosion Tests"—Current (1952–To Date)

Project No. 16. "Mechanism of Electrodeposition," University of Pennsylvania—Current (1955–To Date)

Project No. 17. "Microthrowing Power," Virginia Institute for Scientific Research—Current (1955–To Date)

Project No. 18. "The Mechanical Finishing of Metal Surfaces," National Lock Company—Current (1955–To Date)

(Only those Research Project Serial Reports listed on page 366 are available, all others are out of print.)

RESEARCH COMMITTEE CHAIRMEN

(Origin through AES Golden Jubilee)

1923–1924	William Delage
1924–1925	R. L. Shepard
1925–1926	Frank J. Hanlon
1926–1929	R. J. O'Connor
1929–1933	Jacob Hay
1933–1936	William M. Phillips
1936–1938	George B. Hogaboom
1938–1941	Austin B. Wilson
1941–1943	Erwin Sohn
1944–1946	Carl E. Heussner
1946–1947	Ellsworth T. Candee
1947–1948	Dr. Richard M. Wick
1948–1949	Dr. Louis Weisberg
1949–1950	William M. Tucker
1950–1951	Dr. W. Andrew Wesley
1951–1952	G. M. Cole (Died Aug. '51) Dr. Donald Price
1952–1953	Dr. Donald Price
1953–1954	Dr. Earl J. Serfass
1954–1955	Dr. Earl J. Serfass
1955–1956	Leslie C. Borchert
1956–1957	Arthur H. DuRose
1957–1958	Robert A. Ehrhardt
1958–1959	Dr. Russel E. Harr

BUREAU OF STANDARDS GOES OVER THE TOP

Doc Blum's gang came down like a wolf on the fold,
And they captured our George* from the Scovill's, we're told.
We sure cannot blame them, they never will rue it,
For it's playing the game safe, to just let George do it.
Then the Bureau of Standards went looking for more,
And Thomas F. Slattery from Bridgeport they tore.
Thus strengthened, they went and invaded the West
And like Young Lochinvar, they copped out the best.
Though Uncle Sam calls, it brings tears to our eye,
For they've been and took smiling Fred Liscomb from Chi.
If our country needs him, we'll spare him awhile,
But Fred, as you love me, hang on to that smile.

Reprinted from
MONTHLY REVIEW
of September 1918

* George P. Hogaboom

RESEARCH PROGRAM SUPPLEMENT

A PLATING MAGAZINE original feature during this observance fiscal year of the FIFTIETH ANNIVERSARY of its parent, American Electroplaters' Society, Inc.

FROM the inception of the AES in 1909, it has always been considered an "Educational Society". As such, it was early interested in researches in this field and their possible application to industrial practice. In 1913, George B. Hogaboom, just elected as the first president of the AES, presented to the American Electrochemical Society his paper on "Unsolved Problems in Electroplating". In 1915, he offered to present to the American Electrochemical Society as subjects for research, any problems sent to him through the AES.

When in 1917, this writer presented to the AES Convention, a report on the plating researches at the Bureau of Standards, George Hogaboom strongly urged the AES to cooperate with the Bureau. In 1918, during World War I, this cooperation involved the employment by the Bureau of three experienced AES platers, namely George B. Hogaboom, Fred J. Liscomb and Thomas F. Slattery.

In 1919, the AES supported efforts then being made to secure funds for continuation of the plating researches at the Bureau of Standards. The first AES Research Committee was appointed in 1923. An advisory committee to the Bureau of Standards was also appointed and met there in November 1923.

In 1925, the AES Research Committee issued an appeal for subscriptions at the rate of $50 per year from manufacturers, for a three year program. By January 1927, sufficient funds were raised to start the employment of W.P. Barrows as a Research Associate at the National Bureau of Standards (NBS). Since that time, except for a few years during World War II, one or more AES Research Associates have been employed at the Bureau.

THE FIRST study of Barrows was on "Spotting Out", followed by one on "Throwing Power in Chromium Plating" by H. L. Farber, and one on "Porosity of Chromium Coatings" by Barrows.

In 1930, plans were made for a study of the "Protective Value of Plated Coatings" in cooperation with the AES, the ASTM, and the NBS. P.W.C. Strausser was appointed as Research Associate, and by 1932, the many required specimens were prepared and exposed in six locations. This work was continued in spite of the fact that during the depression in 1932, the Research Committee had to borrow funds from Branches and firms. At that time, Jacob Hay, then Chairman of the Research Committee, recommended an assessment of $2 per member for research, a plan not adopted until many years later. The results of the exposure tests were published between 1934 and 1940 and served as a partial basis for the "Joint Specifications for Electroplated Coatings" that were compiled and distributed through the ASTM.

In 1938, an AES research was started at NBS on the "Effects of Polishing Steel on the Protective Value of the Plated Coatings", with G. A. Lux as Research Associate. Owing to World War II, the results were not published until 1945.

UP TO THIS time, the AES Research Committee was appointed each year, occasionally with sufficient change in personnel to prevent adequate continuity. In 1944, the Research Committee was reorganized to consist of nine members, three to be appointed each year by the AES Executive Board. This arrangement has since then proved highly effective, as it gives an opportunity for a member to become acquainted with the research activities before he assumes a responsible position as Chairman or Vice Chairman. Carl E. Heussner, who developed this plan, was the first Chairman, succeeded each year by an experienced member. William Blum was then made an Honorary Member of the Research Committee.

This new committee originally planned to maintain 400 Sustaining memberships at $100 each. While this goal has not been fully realized, sufficient funds have been raised to support six or more researches, and to build up a modest reserve to insure continuation of studies if, for any period, inadequate funds are obtained. Each AES member now contributes one dollar per year to the Research Fund.

GREATER resultant funds permitted establishment of AES projects in a number of universities and research foundations in the United States and Canada. This arrangement is advantageous because it enlists the interest of a larger group of scientists, and also stimulates study of electroplating by students. Among the first of the new projects was the "Adhesion of Electrodeposits" by A. E. Ferguson at the University of Michigan.

A new series of "AES Research Serial Reports" was started in 1946, of which 39 have thus far been published, in addition to the 8 papers previously published. Those reports that are not "out of print" can be purchased from the AES. Fortunately, most of them appeared in the MONTHLY REVIEW or PLATING MAGAZINE, and are hence available in libraries.

At intervals, the AES membership has been asked to suggest subjects for research, many of which have been adopted by the Research Committee. The subjects of the studies cover a wide range of interest. Efforts have been made to devote study to subjects of direct present interest, and also to fundamental principles, a greater knowledge of which is essential to future progress in electroplating.

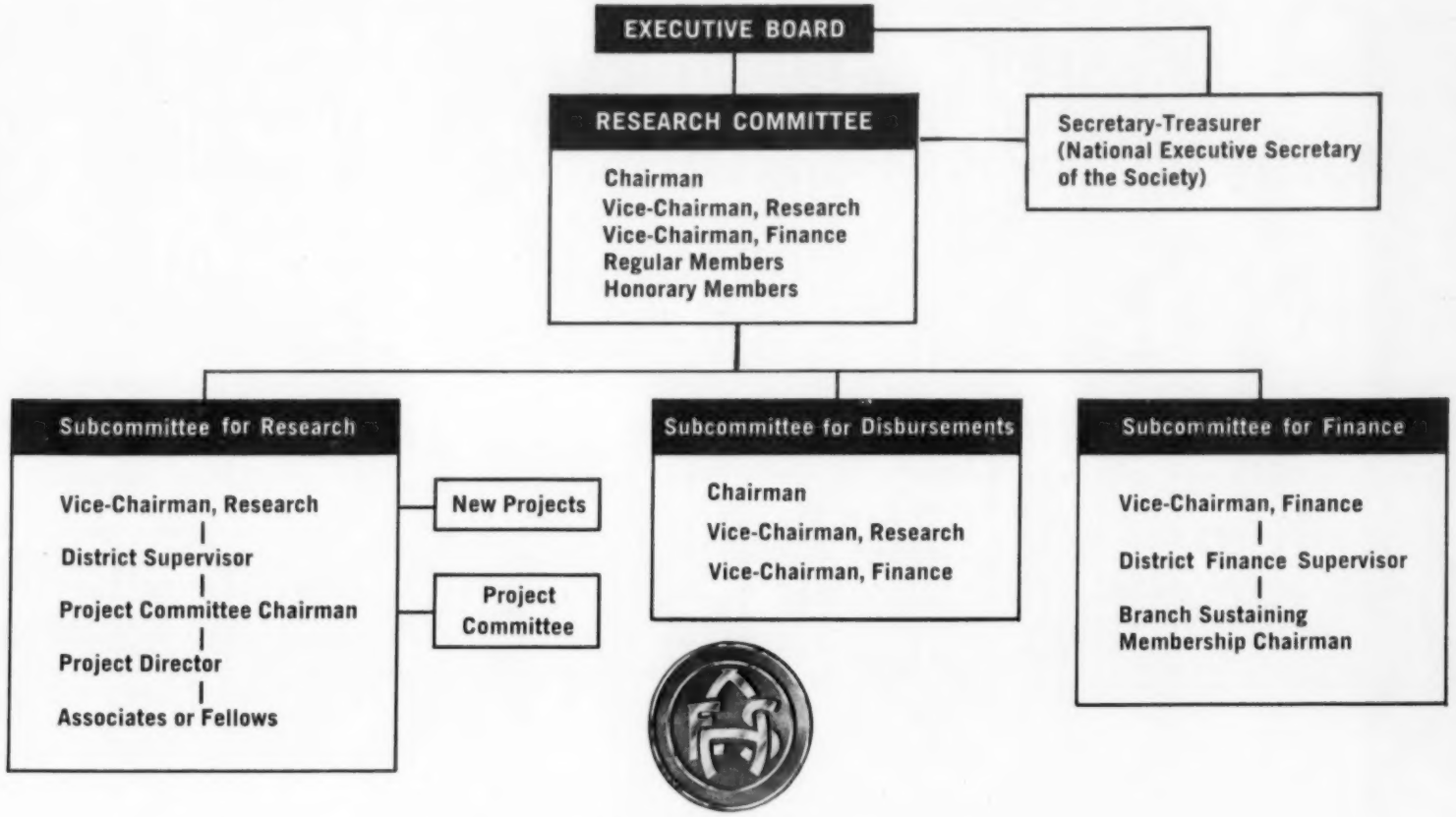
THE outstanding success of the AES Research Program is a result of the interest and devotion of Research Committee members, and of the much greater number of AES members who serve on various Project committees, all without compensation. All the funds collected for research are spent directly for conducting the studies and publishing the results. There is close and cordial cooperation between the Research Committee and related organizations, including the ASTM through its B-8 Committee; and the Electrochemical Society through its Electrodeposition Division.

These united efforts have promoted progress in this industry, and will enable it to meet the inevitable competition with other methods of metal finishing. Research must go on!

—WILLIAM BLUM

Dr. Blum has been associated with AES Research since its origin and is consequently best qualified to create this Research Program Supplement of "Milestones of AES". The Society and PLATING acknowledge his cooperation gratefully.—John P. Nichols

RESEARCH PROGRAM
ORGANIZATIONAL CHART OF THE RESEARCH COMMITTEE



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James D. Thomas

THE AES RESEARCH PROGRAM

by JAMES D. THOMAS
Vice-Chairman, Research

THE PREAMBLE OF THE Constitution of the American Electroplaters' Society says "The object of the Society shall be the improvement and dissemination of the knowledge of the arts and sciences of electroplating and of finishing of metals and of allied arts, the development of a cooperative spirit of friendship, and mutual assistance among its members."

The Research Program is aimed at improving the knowledge of the art and science by sponsoring projects at various sites. It is felt that a proper balance is maintained between the support given to "basic" and "applied" investigations. The dissemination of this knowledge is given by reports such as this annual summary in the Research issue of PLATING, by Publication of Serial Reports, and by papers presented at Annual Conventions and at local Branch meetings. Mutual assistance among its members is, in a broad sense, attained by the financial support of each individual member of the Society and of the Sustaining Members; without this support, the Research Program would not be possible.

The Project Summaries which follow are reports of the progress made during the past year. Previous reports were published in the April 1958 and the May 1957 issues of PLATING.

SUMMARIES OF AES RESEARCH PROJECTS

AES Project No. 12

CLEANING AND PREPARATION OF METALS FOR ELECTROPLATING

Work has continued on the study of oil spreading rates as related to the ease with which these same soils may be removed from metal surfaces by alkaline cleaners. The equipment has been modified to eliminate air-borne contaminants and thereby obtain better reproducibility of results. Studies have been reinitiated to determine the relationship between spreading rates and percentage composition of mixtures of stearic acid (a non-spreader) and mineral oil.

The studies of the effect of oxides on the adhesion of electroplates was published in PLATING.[1,2] During this past summer, work was started on the effect of organic films (stearic acid) on adhesion of electrodeposits. It appears from preliminary data that useful information will be obtained from this phase of the studies on adhesion.

REFERENCES

[1]Plating, **45**, no. 4, pp. 349–359 (1958).
[2]Plating, **45**, no. 7, pp. 728–733 (1958).

Project Director—
H. B. LINFORD

Project Fellows—J. DESMOND, J. GRUNWALD and W. P. BROWN
Location—Columbia University

AES Project No. 13

THE NATURE, CAUSE AND EFFECT OF THE POROSITY IN ELECTRODEPOSITS

Project Director—
FIELDING OGBURN

Project Fellow—
DR. D. W. ERNST

Location—National Bureau of Standards

Detection of porosity in nickel coatings on steel has been reported by using a ferroxyl test. The sensitivity of this test was determined by comparing it with the contact photographic process. Pore size was measured with an optical filar micrometer. It was found that the detection of pores by the ferroxyl test appeared to be a function of deposit thickness and pore size; 80 per cent of the observed pores 0.5 mil in diameter were detected by the feroxyl test while only 20 per cent of the pores 0.1 mil in diameter were detected.

Investigations have been started on the detection of porosity in decorative chromium deposits. The methods being studied are copper deposition at a low potential and electroless nickel deposition. Both methods are based on the fact that the metal will deposit on nickel (exposed through the chromium) but not on passive chromium surfaces.

AES Project No. 14

THE INFLUENCE OF PHYSICAL METALLURGY AND MECHANICAL PROCESSING OF THE BASIS METAL ON ELECTROPLATING

Project Director—
M. H. JONES

Project Fellow—
J. ZAJDOWSKI

Location—Ontario Research Foundation

A paper[1] was presented at the AES Annual Convention in Cincinnati in May 1958. This paper covered the studies on mechanical polishing of the basis metal. A paper will be presented at the AES Annual Convention and Fifth International Conference on Electrodeposition and Metal Finishing in Detroit in June 1959. This paper will outline the progress of the work of the past three or four years.

The effect of stresses in the basis metal was studied because many articles are subjected to forming or drawing operations prior to plating. Tensile test specimens were subjected to various applied loads and plated with Watts nickel. The Corrodkote test was used to evaluate the corrosion resistance of the first set of specimens. Additional specimens were evaluated in the acetic acid salt spray test. Corrosion resistance was found to be dependent on the amount of elongation applied, on whether the specimens were polished before or after extension, and the direction of polishing in relation to the direction of extension.

REFERENCE

[1]45th Annual Technical Proceedings, AES, pp. 45–52, 1958.

AES Project No. 15

ACCELERATED CORROSION TESTS

Three accelerated corrosion tests for decorative plating exposed to out-of-door service have been developed. Specific operating instructions have been formulated. At present the Corrodkote and copper chloride modified acetic acid salt spray tests are being used extensively for evaluating the corrosion resistance of plated parts.

Papers describing these tests and experiences with their use will be presented at the AES Annual Convention and International Conference on Electrodeposition and Metal Finishing in Detroit in June 1959.

Project Chairman
W. A. PINNER

Location—Detroit Area

AES Project No. 16

MECHANISM OF ELECTRODEPOSITION

Project Director—
J. O'M. BOCKRIS

Project Fellow—
M. ENYO

Location—University of Pennsylvania

A large portion of the work of this project is reported in this issue. The report, prepared by Dr. Bockris and Dr. B. E. Conway, is titled "An Introduction to Fundamental Research on the Mechanism of the Electrodeposition of Metals."

The Joint Conference of the Bureau of Standards and AES Research Committee, Washington, D. C., November 15, 1924.

AES Project No. 17

MICROTHROWING POWER

Project Director—
H. LEIDHEISER JR.

Project Fellow—
MRS. L. B. GARMON

Location—Virginia Institute for Scientific Research

Data have been obtained to determine the effects of metal ion concentration, type of anion, and current density. It is indicated that the total amount of nickel deposited in the crack of the test specimen was approximately linearly related to the metal ion concentration. It has also been found that the anion has an influence on the amount of nickel deposited. Increasing the current density tends to decrease the microthrowing power of nickel baths.

A paper covering the work of this project will be presented at the AES Annual Convention in Detroit in June 1959.

AES Project No. 18

MECHANICAL FINISHING OF METAL SURFACES

The literature search has been published as AES Research Report, Serial No. 39. The first studies, using the experimental buffing machine, were concerned with wheel pressures, wheel speeds (surface feet per minute) and table speed for buffing zinc base die castings. Twenty-five experiments, statistically designed, showed that the buffing effect increased with increasing wheel pressures (10 to 22 pounds), with decreasing rable speeds (25 to 10 feet per minute), and with decreasing wheel speeds (8385 to 4402 surface feet per minute).

The second study extended the range of the previous tests and included the amount of buffing compound. The results have not been completed at the time of this writing.

Project Director—
W. C. GEISSMAN

Project Fellows—
K. GATCHELL
and
GERHARDT NAUSNER

Location—Rockford, Illinois

KNOWLEDGE OF INESTIMABLE VALUE IN THESE AES RESEARCH PROJECT REPORTS CURRENTLY AVAILABLE

Cleaning and Preparation of Metals for Electroplating, IV, V, VI & VII—By H. B. Linford & E. B. Saubestre — *Serial 26, Project 12, $3.50*

Methods for Testing Thickness of Electrodeposits, II & III—By H. J. Read & F. R. Lorenz — *Serial 27, Project 7, $1.35*

Porosity of Electrodeposited Metals—By N. Thon, D. G. Kelemen, L. Yang, S. Yang, D. Dean — *Serial 28, Project 6, 85 Cents*

The Analysis of Electroplating Solutions for Major Constituents—By E. J. Serfass & M. H. Perry — *Serial 29, Project 2, 90 Cents*

Effect of Basis Metal Condition on Plating, I & II By A. E. R. Westman & A. F. Mohenheim — *Serial 30, Project 14, $1.10*

Effect of Surface Finishing on Nonferrous Base Metals on Protective Value of Plated Coatings—By G. J. Kahan, W. W. Macchia, J. M. Fairbank — *Serial 31, Project 4, 45 Cents*

How the Small Electroplater Can Treat Cyanide Plating Waste Solutions with Hypochlorites—By Bernett F. Dodge and Walter Zaoban, Yale University, New Haven, Connecticut — *Serial 33, Project 10, 50 Cents*

Effects of Impurities and Purification of Electroplating Solutions, IX, X & XI—By Dr. D. T. Ewing, Dr. A. J. Smith & Dr. W. O. Dow — *Serial 34, Project 5, 50 Cents*

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The Nature, Cause and Effect of the Porosity in Electrodeposits, I & II—By Fielding Ogburn, Asaf Benderly and Margaret Hilkert — *Serial 36, Project 13, $1.00*

Microthrowing Power, A Literature Search—By Esther B. Leffler and Henry Leidheiser Jr. — *Serial 37, Project 17, 75 Cents*

The Influence of the Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating IV—By M. H. Jones, Chih-Yeu Lu and J. Zajdowski — *Serial 38, Project 14, $1.25*

Mechanical Finishing of Metal Surfaces—Bibliography—By C. E. Kennedy, J. E. Fritts, R. S. Modjeska, L. E. Weeg & R. V. Twyning — *Serial 39, Project 18, 50 Cents*

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AES RESEARCH PROJECT NO. 16

AN INTRODUCTION TO FUNDAMENTAL RESEARCH ON THE MECHANISM OF THE ELECTRODEPOSITION OF METALS

by B. E. CONWAY† and J. O'M. BOCKRIS*

An attempt is made to explain the type of work done in fundamental research on the mechanism of metal deposition. The object is to ascertain: (a) The structure of the electric double-layer, (b) the structure of ions in solution which give rise to electrodeposited entities, (c) the path and rate-determining step in the metal deposition. An explanation of the technical terminology of the work is given in an appendix.

Particular techniques, especially pre-electrolysis, and the introduction of clean surfaces into the solution, are discussed.

Some experimental results of one fundamental investigation on the ac impedance of the copper solution interface are given. The interpretation of these results is briefly discussed. They are consistent with the view that the transfer of ions is largely rate determining except near the reversible potential.

It is also possible to make a purely theoretical approach to metal deposition kinetics and the type of result ensuing from this is described.

I. INTRODUCTION

THIS PAPER REPRESENTS AN ATTEMPT to describe to the electroplater who understands the basic ideas of electrochemistry, what is being done in research on fundamental electrode processes, and in particular how electrochemical workers are tackling the problem of finding out the sequence and nature of the ionic and molecular events which occur during electroplating. One value of such work is as a foundation on which substantial advances in practical electrodeposition can be made.

Accordingly, problems which are the object of research in fundamental work on electrodeposition are described. Some typical experimental techniques which have been used in fundamental work are then presented, and a brief outline is given of how one particular piece of experimental research was carried out. Some terminology and ideas which fundamental electrochemists use in discussing the mechanism of electrodeposition are informally defined. Finally, a summary is given of how evidence concerning the rate-determining step in a typical simple metal deposition reaction has been obtained in recent fundamental research carried out at the University of Pennsylvania and the University of Ottawa as part of AES Research Project No. 16. It is shown how not only fundamental experimental work, but also purely theoretical considerations, can contribute to the evaluation of the detailed molecular mechanism of metal deposition.

Practical work is being served by this research. Electroplating as it is generally practiced has "just grown." The basic mechanisms are little understood, since the theory of electrode kinetics has existed in any depth for only some ten years. This article is an attempt to bridge the wide gap between practice and theory in the metal deposition industry.

II. TYPICAL PROBLEMS CHOSEN AS THE SUBJECTS OF FUNDAMENTAL WORK IN METAL DEPOSITION

Since the basic problem in metal deposition is the discovery of the molecular mechanism which occurs when a metal ion is deposited electrochemically on a metal of the same species,

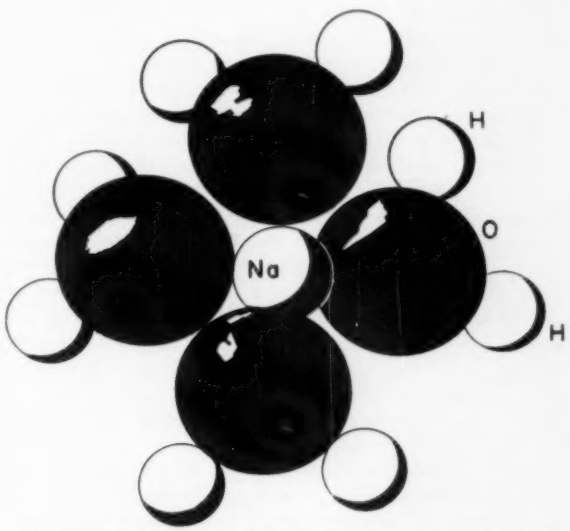

Fig. 1. Sodium ion with hydration sheath containing four water molecules.

† Chemistry Department, University of Ottawa, Ottawa, Canada.
* John Harrison Laboratory of Chemistry, University of Pennsylvania, Philadelphia 4, Pennsylvania.

the following are the three general questions to be answered in order to obtain complete understanding of metal deposition.

(1) What is the structure of the electric double layer at the metal/solution interface?

At the present time, only the structure of the mercury/solution interface is known in detail.[1] The "structure of the interface" means how the ions together with their hydration sheaths (Fig. 1) on the solution side of the double layer and how the electrons on the metal side of the double layer are arranged as a function of distance from the metal-solution boundary. In what way, and at what concentration, are the solvent molecules arranged at the interface? (In particular, with positive ends of the dipoles inwards or outwards?) Are the anions of the electrolyte simply distributed in the electrostatic field near to the electrode, or are they attached to the electrode by chemical binding forces of a non-coulombic nature? What is the strength of any of the metal-ion or metal-solvent molecule bonds formed? (Correspondingly, how much work does an ion which is approaching the electrode have to do in displacing one of the adsorbed particles on the electrode so that it can find a place for itself?) How do the quantities mentioned above depend upon temperature, concentration, and composition of the solution? With what kind of bond and with what bond strength are additives adsorbed on the electrode? What are the contours of the basis metal before deposition begins? What is the ratio of true to apparent surface areas on the metal and how is this influenced by the adsorption of solvent, anions and additives? What is the magnitude of the potential difference at the metal-solution interface created by the layer of adsorbed solvent molecules?

Such questions concerning the structure of the double-layer exemplify the kinds of information which the fundamental chemist must try to obtain *before* he tackles the central problem of the mechanism of electrodeposition. Without such knowledge, particularly that concerning the amounts of adsorbed molecules attached to the electrode, he is limited in what he can do in evaluating mechanisms, because he is not sure what is on the electrode surface. He is like somebody attempting to ascertain the path of the movement of another person in a dark room by the sounds he hears, when he does not know the objects in the dark room against which the person is knocking.

One of the reasons why little has been done in this field of the structure of the solid-metal-solution interface is that the work is very difficult. In work on the structure of the electrical double-layer at mercury, it is possible to use the electrocapillary curve (i.e., the relation between the surface tension of the metal-solution interface and its potential difference), which allows the application of some rather general thermodynamic reasoning to the relations between the dependence of the surface tension on concentration and the amounts of adsorbed material present.[2, 3] The metal-solution interfacial tension when the metal is a solid is a much less accessible experimental quantity than it is with mercury.[4] Consequently, methods used for the study of the solid-solution interfaces are quite different from those involving a liquid metal. These include direct measurement of adsorption by means of radioactive tracers;[4] the use of a pendulum device[5] by means of which the potential of the metal-solution interface, when there is no surface charge on the metal, can be obtained; the use of ac bridge measurements to obtain the capacitance of the metal-solution interface,[6] which may, in the presence of certain supporting information, be made

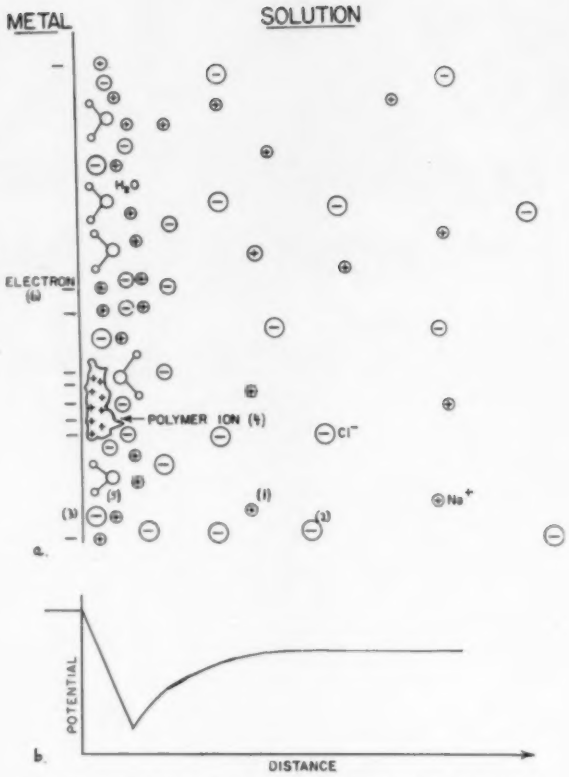

Fig. 2a. The distribution of ions and dipoles in the electrical double-layer. (1) cations, (2) anions, (3) specifically adsorbed anions, (4) adsorbed additives, (5) adsorbed water dipoles, (6) electrons.

Fig. 2b. The potential as a function of distance in the double-layer (corresponding to (a)), measured from the metal surface.

to yield the amounts of the various constituents adsorbed at the interface (see Fig. 2); and finally, direct spectrophotometric determination.[7]

(2) What is the constitution of the ions in the solution which are the source of the electrodeposited entity?

It is obvious that there are "two sides" to the problem of metal deposition mechanisms: the electrode and the solution side. The essence of the problem in the latter case is knowledge of the constitution of the ions which yield the metal atom which is deposited. This problem may be subdivided into two parts.

In very simple solutions of ions which do not usually form complexes, for example, in an acidified $CuSO_4$ solution, the nature of the depositing ion is always obvious, e.g., Cu^{++}. However, there is still the problem of the constitution of the hydration sheath of such an ion, namely, its shape and size in pure aqueous solutions and its composition if organic molecules are present to share it with the water. This is certainly a question of enormous importance which is tacitly avoided in many discussions because we usually write equations for electrode reactions without mentioning the solvation sheath. It is just this environment which is responsible for many of the differences between aqueous, non-aqueous, and molten salt deposition—and so it must be better understood,

if the ionic mechanism of deposition is to be elucidated in a given system.

Determination of the constitution of a solvation sheath, e.g. for Na^+ (see Fig. 1), has recently become moderately well understood.[8] However, the methods which are now available have been applied almost exclusively to the alkali and alkaline-earth metal ions,[9] and there is a considerable deficiency in our knowledge of the solvational properties of those metal ions which are of interest in technical plating processes; correspondingly, difficulties exist in the evaluation of deposition mechanisms involving such ions in practical systems.

In many, perhaps most, technically important solutions, the ions which electrodeposit are not simple; they are complex ions, sometimes anionic. A classical example is the complex formed when KCN is added to a solution of a silver salt. A complex ion $[Ag(CN)_2]^-$ is formed and the deposition of silver can occur from such solutions of this anion.*

Knowledge of complex ions in *aqueous* solutions is relatively good, although little is known of their behavior in solutions as modified for plating practices, e.g., at elevated temperatures or in the presence of organic substances. However, an almost complete lack of knowledge exists in the case of non-aqueous solvents (where a good deal of the future of plating processes may lie) or in molten salts, where explicit methods of evaluating the constitution of complex ions have been obtained only in recent months,[10] and very few results are as yet available.†

(3) What is the mechanism?

The central questions which the fundamental research worker asks about an actual deposition process itself (having discovered, as indicated above, the constitution of entities in the solution comprising the ion, and the structure of the double-layer, through which the depositing entity has to pass) are these:

(i) What is the *overall* reaction?

(ii) What is the *path* of the reaction?

(iii) What is the *rate-determining reaction* among the several consecutive reactions which make up this path?

(i) *The overall reaction:* For the example chosen, this is obviously:

$$Cu^{2+} + 2e_o^- \rightleftarrows Cu.$$

* The deposition of metals from anions at cathodes is not an anomaly, but a phenomenon which has recently become fairly well understood.[16, 17]

† The Hall-Herault process, namely, the electrolysis of alumina-cryolite melts, which supplies most of the world's needs for Al, is perhaps the only process where something of the constitution of the ions important to the deposition process is known.[11] The knowledge here is available through inference rather than from direct determination.

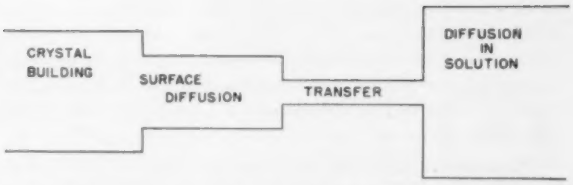

Fig. 3. As in a series of tubes the one with the smallest diameter determines the overall flow of liquid, in a series of consecutive reactions the one with the highest activation energy determines the overall rate of the process. In the diagram this corresponds to the narrow channel called ion "transfer."

If the overall reaction is not obvious, it can be found by classical types of experiments in which the potential of the electrode is measured as a function of the activity of the ions in the solution. The appropriate form of the logarithmic relation between potential and the "activity fraction," i.e. "mass action fraction," of the reactants and products in the overall reaction is then found. As this depends characteristically upon the cell reaction, the latter thereby becomes determined.

(ii) *The path of the reaction:* There are usually several paths to be discussed. Two hypothetical and illustrative paths are given at the bottom of this page.

(iii) *The rate-determining step:* Electrode reactions, like many chemical reactions, consist for a given typical ion, of a series of *consecutive* reactions, as illustrated in A and B below.* In any such series, there is nearly always *one* reaction the rate of which is the bottle-neck for the whole process, i.e., the rate of which controls the rate of the overall process of deposition, and consequently is called the rate-determining step (see Fig. 3). *The concept of the rate-determining step is the central concept in electrode kinetics.* The fundamental research worker regards a knowledge of the rate-determining step in the metal-deposition reaction as the key question, to the solution of which all other investigations are complementary. The central importance of the rate-determining step over all other matters to be investigated in an electrode reaction depends upon the fact that the kinetic behavior of the overall reaction depends on the one rate-determining reaction in every way—other steps have little influence. The rate-determining step is to the overall reaction rate what an overwhelmingly big series resistance is to the current in an electrical circuit containing in addition several other small resistances in series with the large one. To some extent, therefore, the question of the mechanism of an electrodeposition reaction comes down essentially to the *one* question: What is the rate-determining step?

* The consecutive steps undergone by a given ion are, of course, being repeated **simultaneously** by a number of other similar ions at other regions of the electrode.

A

1. Cu^{++} (hydrated in solution). Diffuses to electrode.
2. Cu^{++} (hydrated, at electrode). Diffuses in the solution to crystal building site.
3. Cu^{++} (hydrated, at crystal building site). Transfers into the lattice.
4. [Cu^{++} + 2 electrons]† metal

B

1. Cu^{++} (hydrated in solution). Diffuses to electrode.
2. Cu^{++} (hydrated, at electrode). Is transferred to the electrode surface.
3. Cu^{++} (partially hydrated, attached to the electrode surface as "adion"). Diffuses *across the electrode surface* to a crystal building step.
4. Cu^{++} (adion* at a crystal building step). Becomes a part of the lattice.
5. [Cu^{++} + 2 electrons]† metal

* By "adion" is here meant the entity resulting from the transfer from the solution side of the double-layer to the electrode. The ion still retains at least part of its charge and is therefore an adsorbed ion, or adion.

† The finally deposited copper is represented in this way because it would be misleading to represent a piece of copper as consisting of neutral Cu **atoms** in the literal sense. They are, according to the free-electron theory of metals, cemented together by an atmosphere by electrons.

In the above example of paths in the deposition of copper, only one of the several individual reactions making up the overall reaction is the rate-determining step. Quite recently, methods have become available which allow, in principle, a determination of this rate-determining step.[13, 14] (see section IV, i, ii).

Summarizing this section, it may be said that the fundamental research worker tries to establish which atoms, ions and molecules exist at the beginning and end of the process of deposition. He then lets the deposition process occur (at first under the simplest controlled conditions he can devise) and measures quantities which will give him evidence concerning which, of a number of possible consecutive reactions, controls the rate of the overall metal-deposition process. These consecutive steps together constitute the "mechanism of deposition," concealed, as it were, in the non-descriptive "overall reaction" or stoichiometric equation as usually written to represent the process.

III. EXPERIMENTAL TECHNIQUE

Differences in experimental techniques used in fundamental work and those used in practical plating processes are extreme and originate in the following way. The practical plater is interested in bringing about a combination of many complex circumstances which he finds by experience give him practically useful metallic deposits. The fundamental chemist is interested in breaking the process down to its very essentials, and to do this he has to aim, until he has understood these essentials, at the very simplest possible conditions. He will never find out the mechanism which gives rise to a bright nickel plate from a Watts' type bath if he has not discovered the bricks and mortar of the process—the deposition of nickel from a very simple solution, first; and consequently, unless he has completed these basic studies, there is little prospect of fundamental researches reaching a stage where they can be helpful to practical workers.

This attitude gives rise to emphasis on technique in which as many variables as possible are controlled. Two examples of such techniques will be given.

(i): *The purification of solutions.* The remarkable sensitivity to impurities of electrode reactions in general, particularly at solid-solution interfaces, has been known for only a comparatively short time, and methods for preparing solutions in such a way that the effects of trace impurities in them are reduced to a level where they are no longer effective are relatively new.[15*] Impurities complicate the mechanism of an electrode reaction in two ways. Firstly, the impurities may themselves set up electrode reactions so that the potential and current measured in an experiment are not simply concerned with the intended reaction, but are complex mixed potentials and current densities, and hence useless from the point of view of getting fundamental information. Depolarization of the electrodeposition of hydrogen by oxygen is the best known of such processes,[16] and was one of the causes of the great difficulty experienced for many years in determining hydrogen over-potential at low current densities.

Secondly, some impurities adsorb on the electrode and therefore change the composition and structure of the double-layer. Consideration of this effect shows that a high degree of purification of solutions from adsorbable trace impurities is

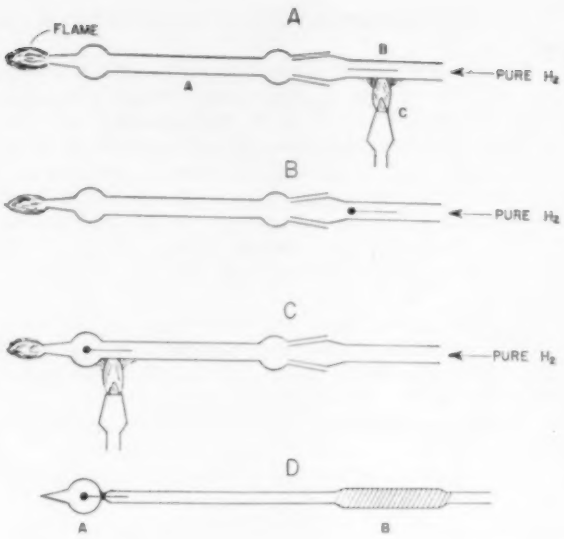

Fig. 4. Electrode preparation. (a) A pyrex tube A is connected with a quartz tube B, a copper wire is heated in an H_2-atmosphere until one end fuses into a sphere. The electrode is then sealed into the glass tube as in C and D.

necessary in order that an electrode reaction may be studied without complicating side effects. Thus, these impurities in a solution do not necessarily remain homogeneously distributed in this solution, but often concentrate at interfaces. In effect, they therefore become preferentially concentrated either on the glass of the cell or on the electrode and certainly with some impurities the adsorption will be preferentially upon the metal electrode. Further, the surface of the electrode is certainly not generally homogeneous and has some areas more likely to adsorb materials than others. To obtain a rough idea of the order of the minimum concentration of impurities which has to be feared, let us assume that all of some particular impurity present in the compartment of an experimental cell (the cell used in this work is shown in Fig. 5) is adsorbed on an electrode of area 1 sq cm and that an effect on the electrode process is noticeable when one-tenth of the apparent surface area of the electrode is covered. Now, since about 3×10^{-7} grams of a small sized molecule (e.g., H_2S, As_2O_3, etc.) is sufficient to cover 1 sq cm of an electrode, we have to fear 3×10^{-8} grams of impurity in the cell solution. A typical experimental cell may have 100 ml of solution in the compartment containing the electrode, so that, with our present assumptions, this 100 ml must contain less than 3×10^{-8} grams of impurity, i.e., less than one three-thousandth of a part per million. Measurable effects caused by traces of this order have indeed been detected.[15]

There is no chance of purifying solutions to this degree by normal chemical methods such as distillation or recrystallization, although these methods must clearly be used in the initial stages of purification. Pre-electrolysis* has been found to be the most useful method. The technique of this method

* The fact that impurities can affect electrode processes has been known for many years and has been made the basis of the "addition agent" part of the technology of electroplating. However, it had not been generally realized until comparatively recently that the magnitude of the quantities involved was less than that required to cover the electrode surface with a monolayer.

* There is a similarity between this process of pre-electrolytic removal from solutions of small traces of impurities and that of "dummying" in technological electrodeposition. The removal of trace impurities by electrodeposition was first carried out by Lewis and Jackson,[21] in 1908, although the technique was not developed further until recent years. The origin of the pre-electrolytic method for the purification of solutions is sometimes quoted as the paper of Bockris and Conway[15] in 1949, and that by Azzam, Bockris, Conway and Rosenberg[20] of 1950. These papers describe the first quantitative examination of the process, discussion of its theory, and application to solid metal electrodes. As is well known, a form of pre-electrolysis has long been used in bright nickel plating.

consists of (a) inserting a scavenger (or dummy) electrode into the solution in which the fundamental measurements are to be carried out, (b) allowing electrolysis on one or more scavenger electrodes to occur for a period, determined by experiments, such that no further change occurs in the experimental results if the time of pre-electrolysis is further increased, (c) removing the scavenger electrode from the solution and inserting a test electrode. The period of pre-electrolysis depends upon the detailed conditions of the experiment, the concentration of the solution, type of salts, etc. A typical condition would be that pre-electrolysis is carried out at a current density of 10 amp/ft^2 for 24 hours in a volume of solution about 150 cc on an electrode 1 sq cm in area.

Pre-electrolysis purification is not used exclusively to eliminate interference in electrode reactions by trace impurities. Other methods, for example adsorption on sheets of palladized asbestos,[22] may be helpful. The importance of pre-electrolysis is in removing very small traces, *after* other methods of purification have removed grosser quantities.

(ii) *The preparation of electrodes.* The type of surface (planes with particular orientation, single crystals, polycrystals, etc.) of the metal used in a metal deposition process is clearly of importance. More important, however, is the fact that this surface should be reproducible and free from contaminants having the nature of metal oxides, organic fats or greases, etc. This is very difficult to achieve by any method in which the electrode surface is allowed to come into contact with air before insertion into the test solution (which also must not at any time be in contact with air) because of the fact that ordinary air has sufficient impurities to cover any electrode exposed to it with a film within a few seconds.[23] It is not usually satisfactory to rely upon purification of the electrode within the cell, because of the complex changes of solution and the consequent repurification which would then be necessary.

In a method[19] which avoids these difficulties, a spectroscopically pure wire is placed in a glass tube (the glass must be free from arsenic and antimony) and a stream of hydrogen passed through it (Fig. 4). The wire is heated just to the melting point in a stream of highly purified hydrogen. The end melts first and immediately rolls itself up into a sphere, the desirable shape for fundamental experiments because it avoids the special surface conditions associated with "points." After passage of hydrogen for a time and at a temperature sufficient to create a perfectly clean surface (manifested in most metals by specular appearance under a microscope), the bulb is sealed. The electrode is then ready for use. The glass tube to which it is attached may be inserted into a ground glass tube at the top of the cap of the cell and then the cap inserted into the cell before final washing of the interior of the cell. During these operations, neither the electrode nor the holder nor any part of the electrode arrangement is touched by hand—a liberal purveyor of organic impurities. They are handled only by very well cleaned platinum-tipped forceps. After the tube is inside the cell, and much later, after the solution has been prepared, pre-electrolyzed, etc., the thin glass bulb around the spherical electrode is easily shattered by means of a plunger inside the cell and experiments made upon the spherical electrode, which has thus been brought into contact, without contamination, with the highly purified solution.

These examples of technique in fundamental work illustrate the complications needed for simplicity and good definition of the final system.

IV. SOME EXPERIMENTAL ASPECTS OF A RECENT FUNDAMENTAL STUDY

In recent work by the authors on the mechanism of the exchange reaction between copper and acid copper sulfate solution, the measuring cell was as shown in Fig. 5. The glass barrels holding the electrodes were moistened with solution and held in position by metal clips. Grease was rigorously excluded from the cell. Four test electrodes were in the cell,

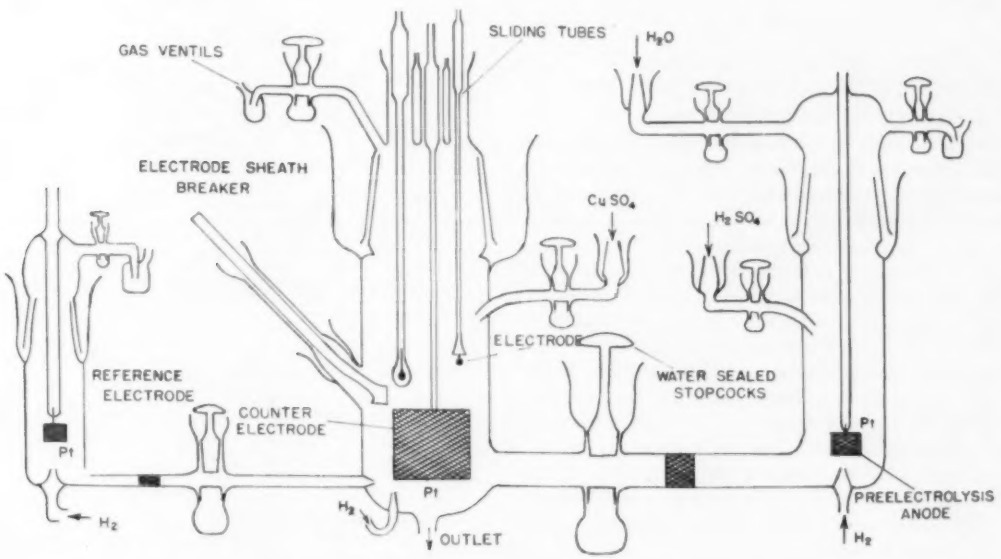

Fig. 5. Cell for measurements with highly purified solutions. The central compartment contains the test electrodes of copper, the right-hand compartment contains an anode for passing a current between it and the copper electrode. The left hand compartment contains a reference electrode for potential measurements.

a fifth served for pre-electrolysis and a sixth consisted of a cylindrical platinum gauze of large area into the center of which the test electrodes could be positioned. A low amplitude ac signal was applied between the test electrode and the gauze electrode which served to form one arm of an ac Wheatstone bridge, thus enabling resistance and capacitance of the cell to be measured. (The fact that the counter-electrode has a very large area and the test electrode a very small one means that in measuring the capacity and resistance of the cell one is, in effect, measuring the small electrode.)

In the investigation cited, most work was carried out with 0.01 to 100 g/l $CuSO_4$ in H_2SO_4 (10 per cent). The cell was cleaned before and after each run with nitric-sulfuric acid mixture and washed with distilled water and equilibrium water ($\kappa = 10^{-6}$ mho cm^{-1}) only. The latter was distilled in helium before entry into the cell and then had $\kappa = 3 \times 10^{-7}$ mho cm^{-1}. For experiments in which sulfuric acid was used, arsenic-free analytical grade sulfuric acid was distilled *in vacuo* in an all-glass apparatus and transferred to the cell in a calibrated transfer pipette closed to the atmosphere. The amount required to give a desired acid concentration was then added to water distilled into the cell through a side arm. $CuSO_4$ crystals (99.99 per cent $CuSO_4.5H_2O$) were recrystallized twice from conductance water outside the cell and twice more in closed flasks under helium, connected with an auxiliary cell containing two copper cathodes, and an anode of Pt, which permitted pre-electrolytic purification of the recrystallized, saturated $CuSO_4$ solution before its introduction into the sulfuric acid solution, which had been previously purified in the main cell by means of pre-electrolysis.

Electrodes were prepared as described above.

The bridge was essentially a simple ac bridge. It contained an oscillator with a range from 5 to 5 x 10^5 cps. To amplify the balanced voltage of the bridge, a symmetrical amplifier was introduced between the bridge and the signal amplifier (a Hewlett-Packard wave-analyzer). Such a bridge is not easy to operate satisfactorily in the absence of a wave-analyzer, because the amplitude of the applied signal is low (5 mv) and balance is difficult to achieve in the presence of a normal amount of noise.

(1) Example of the investigation of the electrode impedance for a copper electrode in a solution of $CuSO_4$

In this work the aim is to evaluate the rate of deposition of copper ions across the double-layer. This may be achieved by determining the impedance offered by the electrode-solution system to an applied ac. This impedance is however complex, containing effectively ohmic and capacitative components, corresponding to processes involved in the transfer of the ions from the solution to the electrode. Its behavior with regard to admittance of the alternating current at various frequencies can best be understood in terms of the simplest network of resistances and capacitances which can be devised, which gives an impedance having the same characteristics as that of the electrode-solution interface. A certain model or "equivalent circuit" (see VII) is set up experimentally (Fig. 6) and the values of the ohmic (R_E, R_L in Fig. 6) capacitative (C_L in Fig. 6) components involved are then evaluated from experimental measurements, using an applied ac at various frequencies.

(i) *Some experimental results in this system:* Electrode capacitance measurements in the absence of $CuSO_4$ in solution, and in the range of potentials where no copper dissolves in the

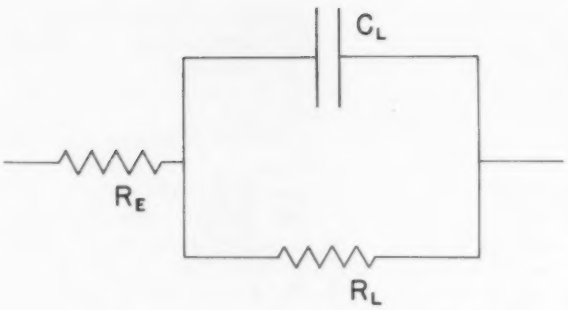

Fig. 6. The equivalent circuit for the electrolytic cell
R_E: electrolytic resistance
R_L: electrode resistance
CL: electrode capacitance.

solution and no hydrogen is evolved, give values of about 70 micro-Farads (μF) per apparent sq cm of electrode area.*

The value of the transfer coefficient† is about 0.4 in the purified solutions of copper sulfate (but about 0.7-0.8 in unpurified solutions). The exchange current density (see ap-

*"Apparent sq cm." The area of an electrode as measured by a traveling microscope is not, of course, the true area, which is greater than the apparent area. It is not easy to determine the ratio between them. However, it is generally found to be between 2 and 3, except for electrodes with very rough deposits when it may become 100 to 1000. If, for smooth electrodes, the ratio is only 2, the effect on the overpotential of neglect of this factor is

$$\Delta\eta = b \log 2. \quad (1)$$

But b is about 0.05 for the deposition of divalent ions, i.e. $\Delta\eta$ is about 15 mv. The experimental reproducibility is about half this amount, which is thus only just significant.

† Definition of this and other terms are given in the Appendix on terminology.

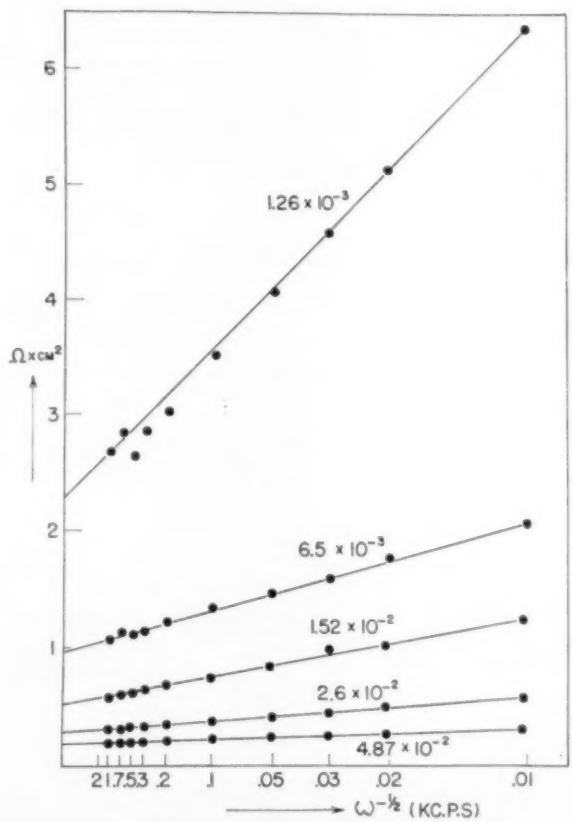

Fig. 7. $R_{Faradaic}$ as a function of $\omega^{-1/2}$.

TABLE I

TYPICAL THEORETICAL AND EXPERIMENTAL VALUES OF $R_{diff.}$

Concentration of $CuSO_4$ g/l	Oz/gal	Experimental $\frac{\partial R_F}{\partial \omega^{-1/2}}$	Experimental $\frac{\partial \frac{1}{\omega} C_d}{\partial \omega^{-1/2}}$	Theoretical $\frac{\partial R_F}{\partial \omega^{-1/2}} = \frac{\partial \frac{1}{\omega} C_d}{\partial \omega^{-1/2}}$ Theoretical for diffusional area equal to 1 sq cm	Area available to diffusion per sq cm of apparent surface
0.55	0.088	31.5	33	15.8	0.48
1.19	0.191	9.4	10.9	7.0	0.65
2.87	0.460	5.7	6.3	3.0	0.50
6.50	0.773	2.3	1.8	1.3	0.72
12.40	1.980	0.66	1.0	1.75	0.75

Notes on Table I: (1) Theoretical values were calculated using a value $D_{Cu^{++}} = 1.4 \cdot 10^{-5}$ cm² sec.$^{-1}$ The appropriate value for Cu^{++} in N H_2SO_4 was obtained as a weighted mean of values calculated from the conductance of 1M $CuSO_4$ by means of the Nernst-Einstein equation and a value obtained polarographically (22) in H_2SO_4 (5 per cent).
(2) The average value of the area available to diffusion for about 50 concentrations is about 0.6 per apparent sq cm.
(3) Technical terms used in the heading of this table are defined in the appendix on terminology (see section VII). C_d is the diffusional capacitance and R_F the Faradaic resistance

pendix), i_o in ordinarily purified solutions was about one half to one tenth that in pre-electrolytically purified solution.

A plot of the Faradaic resistance and capacitance is shown in Fig. 7. It is also relevant to note that the expression for the gradient in the diffusional resistance vs. $\omega^{1/2}$ plot (ω is $2\pi f$, where f is the frequency of the ac used in the bridge by which measurements of the diffusional resistance are made) is

$$\frac{\delta R_{diff}}{\delta \omega^{-1/2}} = \frac{RT}{z^2 F^2} \cdot \frac{1}{A_{Cu^{++}}} \cdot \frac{1}{A'} \cdot \left(\frac{1}{2D}\right)^{1/2} \quad (2)$$

where $A_{Cu^{++}}$ is the activity of the cupric ions (g ions cc^{-1}), z is the valency of Cu, F the Faraday, A′ the area of the electrode to and from which the ions diffuse, and D is the diffusion coefficient (thus A′ can be obtained from (2)).

Finally, it can be shown that the resistance of the reaction is given by

$$R_{Reac.} = \frac{RT}{zF}\left(\frac{1}{i_o}\right) \quad (3)$$

and that, when $\omega^{-1/2} = 0$

$$R_{Reac.} = R_{Faradaic} \quad (4)$$

so that a plot of the Faradaic resistance against $\omega^{-1/2}$ gives the reaction resistance when $\omega^{-1/2} = 0$.

Results obtained with equations (2) and (4) are shown in Tables I and II.

(ii): *General interpretive discussion:* As has been shown above, the ac measurements allow us to obtain values of the exchange current density in the case of a Cu electrode dipped into an aqueous solution of $CuSO_4$. If we do this at various concentrations of copper ions, the exchange current density can be obtained as a function of concentration.
Moreover, it can also be shown that

$$\frac{\delta \ln i_o}{\delta \ln A_{Cu^{++}}} = 1 - \frac{\alpha}{z_i}$$

so that by determining i_o as a function of concentration, the transfer coefficient, α, can be obtained.

Now if the theory of how α should depend upon mechanism is considered, it is possible to make some estimates of values which are characteristic of various rate-determining steps.[13] These values of α are indeed estimates rather than accurate values for they contain within them the assumption that the energy barrier near to the electrode is a symmetrical one. The theoretical estimates of α for a divalent ion like Cu^{++} as a function of the rate-determining step are: (i) for transfer from solution to electrode, about one; (ii) for diffusion across the surface, about two; (iii) for nucleation at growth points on the surface, about four.

Now our value of α was found to be about 0.5 for Cu deposition from aqueous $CuSO_4$ solution, and the nearest of these

TABLE II

MEAN EXCHANGE CURRENT DENSITIES* OF THE FORWARD REACTION $Cu^{++}_{aq.} + 2\,e^-_o \rightleftarrows Cu_{metal}$

Concentration of $CuSO_4.5H_2O$		Mean Exchange Current Densities, i_o	
g/l	oz/gal	amp/sq/dm	amp/sq/ft
0.438[1]	0.070	0.57	6.1
1.62	0.259	1.35	14.4
3.78	0.605	2.70	28.8
6.47	1.035	4.60	49.2
12.20	1.950	7.30	78.0

*See appendix on terminology.

approximate theoretical estimates to which the experimental value approaches is the first one, namely, that for the ionic transfer reaction from a position in the hydration sheath in the solution to some part of the electrode surface. Note that the theoretical estimates given for α above, as a function of mechanism, have an appreciable spread in them, probably about $\pm$ 50 per cent, because of uncertainty (except with the aid of a rather complex theoretical argument) as to the symmetry of the energy barrier at the surface. The value of α observed in this case is about half the mean probable value expected to be characteristic of the transfer step, but it is several hundred per cent (quite outside the probable error) less than the values expected for the other possible rate-determining steps mentioned.

The first, and most important, conclusion, therefore, concerns the rate-determining step as being one of "ionic transfer." Some years ago this step would have been termed "discharge," or even "neutralization." However, the metal itself consists largely of ions, bound together by a cement of electrons, and consequently there is little meaning in talking about the "neutralization" of an hydrated ion during metal deposition. What the term "ionic transfer" means is this: it means the movement of an ion from the position which it reaches in solution just prior to undergoing transfer over the energy barrier, to the position which the still partially hydrated ion reaches when it comes closer to the metal and starts to experience some form of bonding with the metal. The ion has "transferred" from the solution to the metal surface, and will thereafter undergo several steps in the process of crystal formation until it has built into the surface of the metal, i.e., become a part of the metal lattice, or finally complete the electrodeposition reaction.

Thus, the main interpretive conclusion from this example of fundamental work in metal deposition is that, in the Cu-$CuSO_4$ (aqueous) system, "ionic transfer" (see above) is the rate-determining reaction. The characteristics of the kinetics of the electrodeposition of Cu should, therefore, follow any influence which may affect the ionic transfer reaction.

It may be asked: How generally valid is this conclusion for the electrodeposition of Cu^{++} ions? The answer is, of course, that the conclusions apply strictly to the conditions of *p*H, temperature, concentration, current density and solution composition, etc., in the highly idealized system used. There is no reason to expect, however, that so long as the Cu^{++} is not highly complexed by addition agents, and so long as the electrode surface is not made very different from that used here, there will be a change in the rate-determining step. The philosophy of fundamental work, and the very early stage in which fundamental work has been allowed to remain until now, must again be stressed. It is the foundation results, such as those described here, upon which fundamental research can be built to the point where it may lead to advances in practical plating.

(iii): *Implication for metal surface structure:* The results of Table I show that diffusion of the Cu^{++} ions up to the electrode surface occurs only to about half of the apparent area —to about one-fifth or one-sixth of the real area.

This behavior suggests a model in which active centers exist on the electrode surface. The rate-determining ionic transfer from solution to metal thus appears to occur preferentially at these centers, hence denuding surrounding elements of the solution of ions. A concentration gradient from regions of solution adjacent to inactive parts of the electrode to active

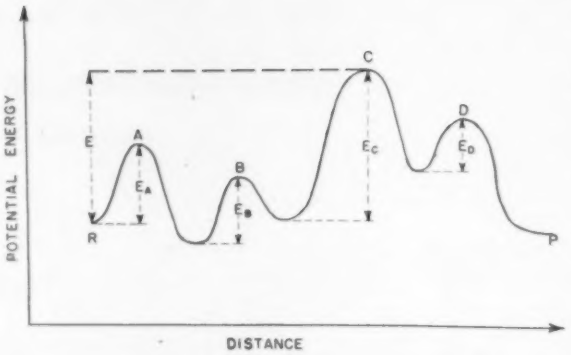

Fig. 8. Activation energies for consecutive reactions: A→B→C →D. The barrier for process C is the highest and controls the rate of the overall reaction in either the forward or backward direction.

parts occurs and the effective area for diffusion is considerably less than the real surface area. The area on to which ionic transfer can occur must be equal to or less than the area available to diffusion, so that the exchange current per true cm^2 must be at least five times larger than that given in Table II for various concentrations. The conclusions arising from this discussion are not inconsistent with the formation of smooth deposits experimentally because the deductions here apply only to the mechanism of the rate-determining ionic transfer reaction and its "transfer area." Growth of planes across the crystal surfaces could still occur as a rapid process all over the electrode surface.

(2) Some purely theoretical concepts and their application to the investigation of the rate-determining step in metal deposition

It has been mentioned that electrode reactions frequently consist of a number of consecutive reactions. The theory of the rate-determining step in consecutive reactions has been treated in a quite general way by Laidler, Glasstone and Eyring.[12] These authors have shown that if a "representative point" in a reaction is considered, and the potential energy of this representative point plotted as a function of distance, the curve will pass through a number of peaks and valleys as shown in Fig. 8. If one of these peaks is a few kilocalories higher than the others, then the configuration of ions, atoms and/or molecules, the energy of which is represented by this highest peak, is the configuration relevant to the rate-determining step[33, 34] All the other smaller peaks then cease to matter for an approximate calculation of the velocity of the overall reaction.

This qualitative and general concept has been applied specifically to electrode reactions by Parsons and by Bockris.[14]

The relevance for metal deposition is this. If the potential energy of a representative point in a metal deposition reaction can be approximately evaluated as a function of distance from the electrode, it is possible to obtain some purely theoretical indication of the way in which a metal deposition reaction must take place, from the point of view of both path and rate-determining steps.

This purely theoretical approach has recently been made by Conway and Bockris.[35] The main difficulties in the calculations arise from uncertainty of the value of the binding energy of the ion to the surface after it has transferred from the solution to the electrode. Such an approach can be

semiquantitative but with a considerable margin of error in the quantities calculated. Nevertheless, if the differences between the energies of various steps is sufficiently great, such calculations give diagnostic information concerning the path and rate-determining step, i.e. mechanism of the reaction.

The results which these calculations indicate are:

(i) It is likely that the path of deposition for the ions concerned is as follows:

(a) Initially there is transfer of an ion from the solution to one of the sites upon the metal shown in Fig. 9, somewhat in the sense discussed above. During this transfer the ion remains partly hydrated. The calculations have shown that the initial transfer step occurs mainly to plane surface sites as shown in the upper diagram of Fig. 9.

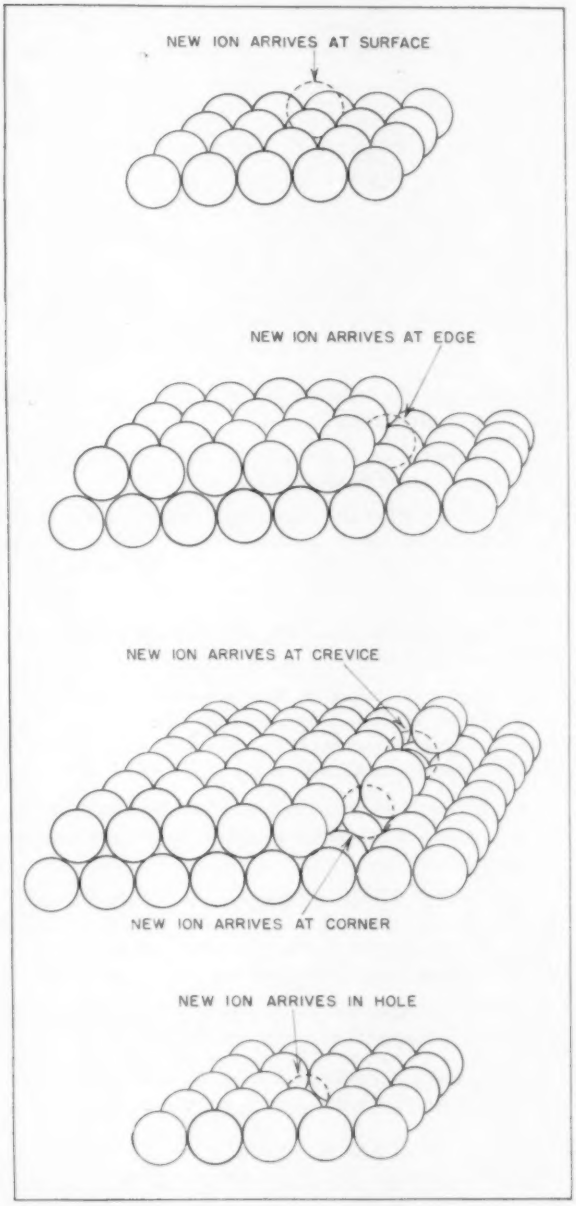
NEW ION ARRIVES AT SURFACE
NEW ION ARRIVES AT EDGE
NEW ION ARRIVES AT CREVICE
NEW ION ARRIVES AT CORNER
NEW ION ARRIVES IN HOLE

Fig. 9. Sites upon the metal surface to which ionic transfer may occur. Transfer of ions occurs mainly to the plane surface sites shown in the uppermost diagram.

(b) Diffusion of the partly hydrated transferred ion occurs across the surface. It continues until the ions meet a growing edge where further dehydration occurs. Thereafter, transfer (or diffusion) of an ion may occur until it meets a corner in the growing planes, whereupon further dehydration takes place. These steps in the deposition of a metal ion are illustrated in Fig. 10. Such diffusion-dehydration steps continue, the ion being coordinated progressively more with other ions, and less with water, until it is finally coordinated entirely with ions (and electrons), i.e., is part of the metal. The successive steps leading to the incorporation of a typical ion I into the metal lattice by electrolytic metal deposition, are shown diagrammatically in Fig. 11. The ion I first arrives at the surface and migrates to a growing edge. Further adions, A,B,C, K,L,M, and X,Y,Z then arrive as its neighbors, gradually building the adion I into the lattice. A similar process could also occur at the corner site shown in Figs. 9 and 10.

(ii): Along this path, the potential energy-distance plots show at high current density one pronounced maximum, namely, that for the transition (or transfer) from the solution to the electrode. The potential energy of the maximum of the energy barrier here is greater than any other potential energy in the system and thus in the cases for which this result has been obtained, the rate-determining step is probably the ionic transfer reaction at the solution-metal interface.

This conclusion of the importance of an electron or an ion transfer step in determining the rate of deposition from solutions in the absence of complexes, does not necessarily apply at low current densities where the number of growth points on the surface is relatively small. Here the diffusion of adions may influence the rate controlling step because the relative absence of growth positions tends to decrease the rate of diffusion between the site of transfer and the point where lattice building occurs.

V. RELEVANCE OF THE FUNDAMENTAL WORK DISCUSSED HERE TO ELECTROPLATING

The general relation between fundamental work on electrodeposition and industrial work has already been mentioned (in IV, 1) and the relevance of the introductory work which is discussed here is that it is one of the initial pieces of work which begins a build-up of fundamental knowledge. When the fundamental work has caught up with the more empirical practical work, the future potentialities of the industry for development are very great indeed, because the necessary insight will be available to shorten work on the solution of new problems.

Even at this very early stage, certain relevant direct connections to mechanisms of practical plating can be seen. The long known facts of the effects of additives in solutions from which metal deposition is occurring, can now begin to be expressed in terms of a model picture. The transfer of the ion from an hydrated state to a state on the electrode surface indicates that modification of the energy of the ion in solution, e.g., by complex formation or change of solvent, will lead to modification of the rate and possibly the mechanism of the transfer process. The reason that adsorbed additives have a marked effect on the course of the reaction is that they modify the sites available to which transfer can occur, and also slow down the surface diffusion of transferred ions and hence

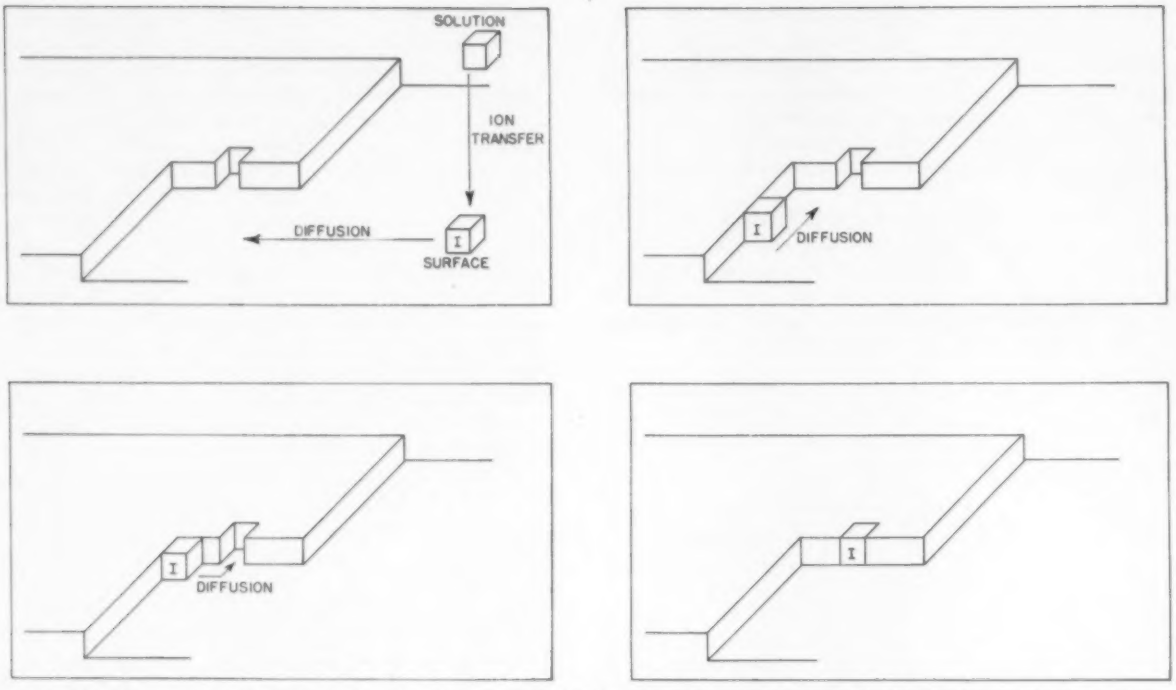

Fig. 10. Consecutive ionic transfer, surface-diffusion and edge-diffusion of adsorbed ions during the building of the metal lattice in electrolytic metal deposition.

affect the lattice growth. The concept of the existence of peaks is consistent with results on micro-throwing and its dependence on the presence of additives.[34] Polar additives will tend to be preferentially adsorbed at regions of high field strength—at peaks—and hence may inhibit further transfer of ions at the peak, thus tending to produce more uniform deposits. *p*H effects can be understood as influencing, among other things, the relative rate of hydrogen deposition compared with that of the metal. Significant hydrogen deposition will cause the presence of adsorbed hydrogen on the electrode which in turn will modify surface diffusion of metal ions and crystal growth particularly on those metals, e.g., nickel, having a large affinity for hydrogen atoms.

VI. SUMMARY

(1) This paper constitutes an attempt to explain the type of work being done in fundamental research on the molecular mechanism of metal deposition.

(2) The general subjects of investigation relevant to finding out the atomic-ionic mechanism of electroplating are: (a) The structure of the electric double-layer at the (solid) metal-solution interface. (b) The constitution of the ions in solutions, which are the source of the electrodeposited metal. (c) The path and rate-determining step in the actual metal deposition reaction.

(3) The technique of fundamental work attempts to reduce any system examined to one with the least possible number of uncontrolled variables. This technique is thus usually somewhat complex. In particular, special techniques—of which pre-electrolysis is an excellent example—must be used for purification of solutions and electrodes must be introduced into the solution in a manner such that their surfaces remain free from contamination.

(4) A brief outline is given of the experimental technique used in one piece of fundamental work.

(5) "The kernel of the objective in fundamental work on the electrodeposition of metals is the evaluation of the nature of the rate-determining step." This statement is discussed.

(6) Some experimental results in one fundamental investigation are described.

(7) The interpretation of these results is discussed: The experimental data are consistent only with the view that ionic transfer is an important step in the rate of exchange of Cu ions between metal and solution.

(8) The metal surface, cleaned under the conditions described, appears to have some active sites to which preferential diffusion occurs.

(9) A purely theoretical approach to the mechanism of electrodeposition is outlined. It supports the interpretation of the experimental results in $Cu/CuSO_4$. It suggests that the rate-determining step deduced may have a wide relevance.

(10) The relevance of this fundamental work to practical progress in industrial electroplating is outlined.

(11) An informal explanation of the terminology of fundamental work in electrodeposition is given in an appendix.

ACKNOWLEDGMENTS

Many thanks are due to the American Electroplaters' Society for their encouraging support of this work, and particularly to the members of the Project Directing Committee for stimulating discussion during its course.

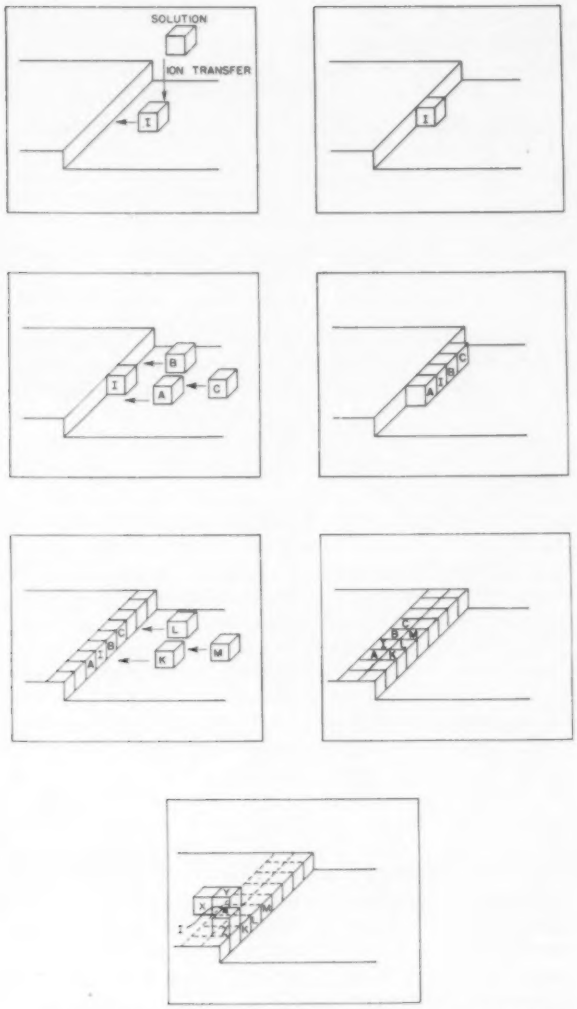

Fig. 11. Incorporation of a typical metal atom or ion I into the lattice by consecutive transfer and diffusion of I together with participation of other atoms A,B,C, K,L,M and X,Y,Z arriving as its neighbors in the growing lattice.

VII. APPENDIX AND TERMINOLOGY

The following terms will be briefly defined or discussed.*

(i): *Reversible (or equilibrium) potential:* This is, e.g., the potential which a metal electrode exhibits when it is in contact with metal ions of the same species in the absence of net current flow.

(ii): *Polarization:* This is a general term which means roughly: "changes in potential which occur as a result of the passage of a current across the electrode-solution interface." Consequently, electrodes which exhibit changes of potential upon passage of current are said to be "polarised." The term "overpotential" (see below) if often used synonymously with "polarization" although the former term can be defined more rigourously.

(iii): *Overpotential* (η): This is the potential of an electrode which is passing current measured with reference to the potential of the electrode in the same solution when it was not passing current.

There are several kinds of overpotential. In all except the German literature, they are divided into three types: one in which the reaction is controlled by ohmic (or resistive) factors in films on the electrode (e.g., the oxidation of tantalum); one in which diffusion in solution limits the supply of reacting entities to the electrode, (such as Cl_2 at an electrode); and one in which activation of reactants at the electrode-solution interface is necessary for the reaction to proceed at a rate corresponding to the current density (for example, in the hydrogen or oxygen evolution reaction).

(iv): *Transfer coefficient:* When dc polarization of an electrode occurs and under certain simplifying conditions,

$$\eta = a - \frac{RT}{\alpha F} \ln i \qquad (6)$$

where 'a' is the Tafel constant characteristic of the electrode process, or alternatively

$$\eta = \frac{RT}{\alpha F} \ln i_o/i \qquad (7)$$

is the experimental result found for the relation between overpotential, η, and current density, i. In this equation, α, which is constant with current density and (usually)[25] with temperature, is called the transfer coefficient, and i_o the exchange current (see below). The name is not altogether a logical one, but some sense in it may be seen if (7) is written as*:

$$i = i_o e^{-\alpha\eta F/RT} \qquad (8)$$

Thus, α is the *fraction* of the energy ηF due to the overpotential and since the current is exponentially dependent upon ηF, α is the coefficient which determines the rate at which ions are, e.g., transferred from the solution to the electrode.

(v): *Exchange current density:* Consider a copper electrode dipped in copper sulfate and weakly polarized cathodically. Like any chemical reaction, an electrode reaction has a backward and a forward direction, so that, in the passage of a net cathodic current (the *net* current is the current which is measured by the ammeter) the current associated with deposition must be greater than that associated with dissolution. In general, the observed net current (i_e) can be expressed as

$$i_e = \overrightarrow{i} - \overleftarrow{i} \qquad (9)$$

where the $\overrightarrow{i}$ is the current density associated with the "forward" (or cathodic deposition) part of the reaction and $\overleftarrow{i}$ is that associated with the reverse (or anodic dissolution) part.

Now, when the electrode is no longer polarized, it can have no further net current flowing across it, i.e., $i_e = 0$. Hence, from (9)

$$\overrightarrow{i} = \overleftarrow{i} \qquad (10)$$

i.e., the partial cathodic and anodic current densities are equal in magnitude and opposite in direction. These equal and opposite current densities at the reversible potential are called the "exchange current density," and represented by i_o (equations 7 and 8) which is usually quoted in amp/sq cm

* The explanations given here are brief and informal. Formal definitions are given in ref. 24.

* It can be seen that this equation resembles that for ordinary reaction kinetics, in which:

$$\text{velocity} = \text{constant} \times e^{-E^{\neq}/RT}$$

and $E^{\neq}$ is the energy of activation.

independent of direction. Frequently, it is loosely called "the exchange current."

The exchange current density is a central concept in electrode kinetics. Thus, the current density which is attained by a certain electrode reaction for a given amount of polarisation (i.e., for a given overpotential), is simply proportional to the exchange current density. Hence, *the exchange current density is a direct measure of how fast or slowly a reaction occurs at a given overpotential.* Reactions like the evolution of hydrogen on mercury, which has a small value for its exchange current density, namely, about 10^{-13} amp per sq cm (10^{-10} amp per sq ft) are called "slow" reactions, and electrode-solution interfaces at which such reactions occur are said to be very "polarisable." Reactions such as the deposition of Ag^+ ions from an aqueous $AgNO_3$ solution have an exchange current density of about 10^{-4} amp per sq cm (10^{-1} amp/sq ft) and are said to be fairly fast. Reactions such as the deposition of Na^+ onto Hg have i_o values of about 10^{-2} amp/sq cm (10 amp/sq ft) and regarded as very fast reactions,[27] (sometimes they are also called "reversible reactions").

The term "exchange current" seems to have been introduced by Bowden and Agar.[29] It is a logical one: i_o is the rate (in terms of current density) at which the ions of a solid metal enter the solution at the reversible potential; and it is also the rate at which ions deposit on the electrode from the solution. Thus, it is the rate at which ions in metal and solution exchange between the two phases at the reversible potential.

(vi): *Rate constant:* In ordinary reaction kinetics, the rate of a simple reaction is taken as equal to the product of the active masses of the reactants, multiplied by a constant called the rate constant. In electrode kinetics, the current density is the analogue of the rate of the reaction. Hence, the exchange current density must contain the product of a rate constant and concentration, and it is possible to show[28] that the relation between rate constant and exchange current is

$$i_o = n_e F \vec{k} \Pi (a), \qquad (11)$$

where $\vec{k}$ is the rate constant for the forward reaction, n_e is the number of electrons which are involved in one of the rate-determining step, and Π indicates the product of the various activities a_1, a_2, etc. of the reactants 1, 2, etc. taking part in the forward direction of the overall reaction.

(vii): *Activation control:* Frequently, and particularly when there is a large supply of the depositable metal ions in the solution, the rate of the electrode reaction is essentially controlled by the actual rate of the electrode process occurring at the interface. Since ions have to be chemically or electrochemically "activated" in order to undergo these reactions, the control of the rate of the reaction in such cases is logically called "activation control."

(viii): *Diffusion control:* If the activation controlled rate of any electrode reaction becomes sufficiently fast, it exhausts the ions in the vicinity of the electrode-solution interface; their diffusion to the electrode then becomes the slow step in the reaction, i.e., the rate-determining step. Such reactions are called "diffusion controlled" reactions.

(ix): *Voltaic adsorption*[30]*:* This is the kind of adsorption which occurs at a double-layer (see (xi)) when the only forces causing the adsorption are purely electrostatic, (Fig. 12A).

(x): *Specific adsorption:* This is the adsorption which occurs when there is an attachment of ions or molecules to the electrode in which the bond (Fig. 12B), is not purely an electrostatic bond.

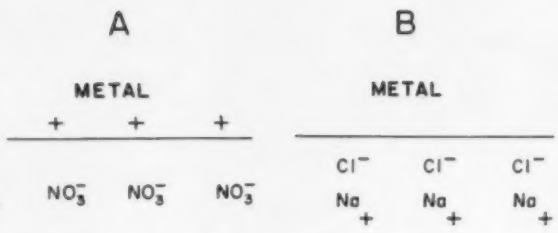

Fig. 12. A) Voltaic or electrostatic adsorption (i.e., non-specific). B) Specific adsorption.[30]

(xi): *Double-layer:* When an electrode potential difference exists at an electrode interface, electronic charges accumulate in the metal at its interface and a corresponding charge of ions is attracted from the solution to a region near the interface of the metal. This system, consisting of opposite charges facing one another at the interface, is called the double-layer.

(xii): *Equivalent circuit:* It is often convenient to represent entities which control the relation between current density and potential at an electrode under alternating current in terms of the imaginary equivalents of these entities regarded as resistances and capacitances arranged to form a circuit that would have equivalent electrical properties, e.g., with regard to the behavior of an ac in the circuit (Fig. 6). This is done in order to facilitate deduction of relations between experimental quantities, such as a resistance measured on a bridge, and the exchange current density of an electrode reaction in a cell, the electrode-solution interfaces of which are the source of the resistance. For example, suppose the double-layer between a mercury electrode and a concentrated KCl solution is considered. In this case, the actual configuration in the absence of current flow is very nearly that of two layers of charges of opposite sign, separated by a vacuum. This strongly suggests that in any electrical circuit which contains the Hg/ concentrated KCl interface, the correct way to represent the corresponding double-layer is as a condenser of capacity C_L (see below).

Suppose now ions were discharged across the double-layer condenser. Then, current could be used up at the double-layer in two ways firstly, by charging of the condenser (regarded as a simple capacitance), and secondly, by actual ionic transport *across* the double-layer. The "condenser current" can be dealt with in terms of the simple equations of electric circuit theory for the charging of a condenser, and the "*Faradaic current*" (that for ionic flow across the double-layer—see xviii) may be treated in terms of a resistance, R_L (see below). The condenser current and the Faradaic current are both simultaneous ways of passing current across the double-layer and, therefore, the "*equivalent circuit*" for the passage of current across the double layer in the example quoted* is a resistance and capacitance in parallel.

Other processes at electrodes can also be represented in terms of ohmic or capacitative components, and then the usual equations of ac theory may be applied to the whole equivalent circuit. If, then, it is possible to find an explicit relation between, e.g., a certain resistance in the equivalent circuit, and some property of the electrode reaction, then ac theory applied to the measurements may allow the extraction of the value of that resistance alone, from the impedance of the whole interface, and the explicit relation mentioned would

* Simplified by the neglect of consideration of diffusion.

then allow evaluation of the parameter of the electrode reaction.

(xiii): *Diffusional resistance:* There is always *some* difficulty in bringing up ions from the bulk of the liquid to the electrode, even though, at low current densities, this may not be the rate-determining step. This difficulty in diffusion can be expressed as a resistance (and an explicit expression can be deduced relating this resistance to the diffusion coefficient and concentration of the diffusing entity, etc.).

(xiv): *Diffusional capacitance:* Consideration of the properties of ac in the vicinity of an electrode, the potential of which is controlled only by the concentration of ions with which the metal is in contact, shows that the properties of the current-potential relation are those which would arise were the diffusion of ions to and from the electrode surface to be regarded as acting as a capacitance and a resistance, the former therefore, being called the "diffusional capacitance." This capacitance is a pseudo-capacitance in the sense that it *represents* certain physical phenomena, which act *as though* they constituted a capacitance, although they do not in fact appear to constitute a capacitance in the normal sense.

(xv): *Double-layer capacitance:* This has been described above (under xii).

(xvi): *Reaction resistance:* The electrode reaction itself (apart from the diffusion which precedes it) represents a resistance (i.e., the difficulty of overcoming the energy barrier at the electrode) and this is the most important term in the ac behavior of an electrode, because it is the term by which the ac behavior is connected with the metal deposition phenomenon.

(xvii): *Double-layer resistance:* If the double-layer itself acts not only as a pure capacitance but rather as a leaky capacitance, like a "lossy" condenser, then it may be said to have a double-layer *resistance.*

(xviii): *Faradaic impedance:* The term "Faradaic" (cf. xii) is used to describe those aspects of processes at electrodes which involve current flow in accordance with Faraday's laws, as distinct, e.g., from current used not in producing deposited metal in accordance with Faraday's laws, but in charging the double-layer. Thus, a combination, for example, of the reaction resistance together with the diffusional resistance and the diffusional capacitance, represents the Faradaic *impedance* of the electrode reaction.

(xix): *Double-layer impedance:* The double-layer impedance arises from the double-layer resistance, R_L, and the double-layer capacitance, C_L, as represented in Fig. 6. The whole *electrode impedance* is made up of the Faradaic impedance and the double-layer impedance.

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NOTES ON ANALYSIS OF SULFATE IN CHROMIUM PLATING BATHS

by J. DUCEY and G. McKINLEY*

A study was made of the effect of temperature on the concentration of dissolved sulfate in chromium plating solutions of the 100:1 CrO_3:SO_4 type. Cooling of solutions below plating temperatures resulted in loss of soluble sulfate. Reheating solutions to plating temperature caused redissolving of sulfate but at a slow rate. The effect of this on the analytical technique for sulfate determination is discussed.

INTRODUCTION

THE IMPORTANCE OF MAINTAINING close control of the chromic acid to sulfate ratio in chromium plating baths is a well-recognized fact. Variations in this ratio have profound effects on the operating conditions of the bath and on the characteristics of the chromium electrodeposits.[1,2] Porous chromium deposits are particularly sensitive to such variations since the type and amount of porosity are a function of this ratio.

Erratic results for the concentration of sulfate radical in production baths were found by this laboratory after any of these baths had been inoperative. Such results might be expected with the self-regulating type bath, but these baths were of the ordinary 100:1 CrO_3:SO_4 type.

EXPERIMENTAL PROCEDURE AND RESULTS

Solution from a production plating tank was cooled to and maintained at 60F by means of a water bath; continuous agitation was maintained throughout the experiment. Samples were withdrawn at intervals, filtered to remove insoluble sulfates and analyzed for sulfate in solution by the conventional gravimetric technique.[3,4] This procedure of analysis has proved to be precise on the order of ± one per cent. The zero-time sample was withdrawn as soon as the solution reached 60F, an elapsed time of about 15 minutes. The results are shown in the graph, Fig. 1. This clearly indicates the loss of soluble sulfate as a function of time at 60F.

This stock solution was reheated and maintained at plating bath temperature for 30 hours. Analyses of the soluble sulfate showed an increase in concentration to 2.50 g/l, this being appreciably greater than the minimum concentration of 2.44 g/l attained at 60F, but still not up to the original soluble sulfate concentration of 2.58 g/l.

Further work showed that periods up to one-and-one-half hours before filtering and analysis are not critical. When longer cooling times are involved, the sample must be filtered as soon after sampling as possible.

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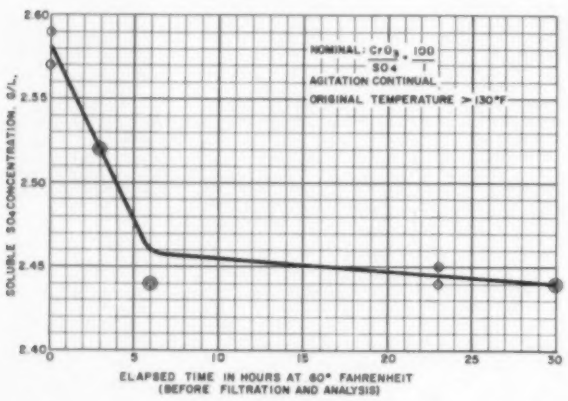

Fig. 1. Change in dissolved sulfate concentration vs. time at 60F

DISCUSSION AND CONCLUSIONS

Present in chromium plating solutions in varying amounts are the cations of barium, calcium and lead. The solubility product of compounds of these ions with the sulfate radical are such that these compounds may form insoluble salts in chromium plating solutions. It follows that the solubility of these salts decreases with a decrease in temperature. Neither the precipitation nor the redissolving processes are instantaneous although the latter is appreciably slower even with agitation.

New baths would not be expected to exhibit this effect. As cations of calcium, barium and lead accumulate in a solution however, the effect of temperature changes becomes important.

All samples from chromium plating baths must be filtered before analysis so that only the effective soluble sulfate is determined. It is extremely important that this filtration be carried out within one-and-one-half hours after removal of the solution from the plating bath. A centrifuge can best accomplish this filtration.

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LEAD PLATING OF CHROME PLATING ANODES

by FRANCIS A. HEISER and JAMES E. HYDE*

Initial studies were conducted on a laboratory scale to develop a process for the continuous lead plating of round copper bars, 2 in. in diameter, 17 ft 6 in. in length for producing chrome plating anodes. Later investigation was expanded to full scale plating. The first work resulted in the production of two successful chrome plating anodes.

A comperison of the old and new methods of fabrication indicates the lead plated anode to be superior, not only in tangible monetary savings, but also in increased safety in working conditions. Data presented also show that the lead plating results in anodes having greater chrome plating accuracy and increased life.

INTRODUCTION

WHEN A GUN is fired, its internal surface is subjected to erosion by the propellant gas and to abrasion by the action of the projectile passing through the tube. Chrome plating is employed to increase wear life which sustains the accuracy of the tube by retarding mechanical and gas erosion. In this application, the rifled area from the breech end to the muzzle end of the tube is plated with chromium varying in thickness from 0.004 to 0.005 inches.

The length of the anode required to plate the bore of a gun tube is dependent upon the size of the gun. The larger gun tubes require anodes to 30 feet in length. In the past, anodes were made in two sections, a solid copper upper section, and a tubular lower section (Fig. 1).

This design emanated from the belief that the accumulation of gases at the upper solution levels in the vertical chrome plating tank produced a larger anode to cathode resistance than at the lower levels. This resistance decreases the current flow and causes the resultant plate to be thinner at the upper regions, resulting in a taper of the plate. The tubular section decreases the cathode current density thereby decreasing the amount of plate in this area and, in theory, eliminating the taper.

A lead coating was applied to the sections by a "lead burning" process. The process was not only slow and costly but resulted in an uneven surface as well as poor bond between the lead and the copper, thus decreasing the anode life for chrome plating.

The objective of this project was to devise and develop a more efficient anode for use in chrome plating gun tubes. Work was limited to development of an anode for chrome plating 90 mm gun tubes.

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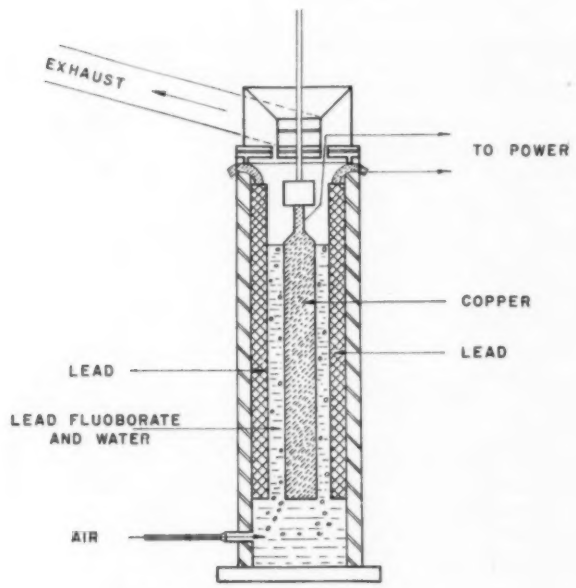


Schematic of the vertical lead plating tank.

PROBLEM

The process of chrome plating the bore of a 90 mm gun tube employs as the anode, a lead coated copper unit, 17.5 feet in length and two inches in diameter.

The anode was previously constructed in two sections, the lower half, a copper tube 9 feet long attached to a solid copper upper section by solder sweating and secured by means of a copper pin at the joint. Lead was applied to each section by "lead burning," a very slow and unsatisfactory process in which the lead is melted with hand torches onto a small area of the copper at a time as shown in Fig. 2.

Because of the generally poor results of this process already mentioned, and its excessive cost, the substitute process of lead electroplating was investigated for possible improvement.

EXPERIMENTATION

A. Initial Experiments

Initial experiments were conducted on the lead plating of small copper specimens. From these tests it was determined that lead could be plated onto copper to thicknesses of 0.125 inches and greater with no intermediate burnishing. In addition, the excellent throwing power of lead was verified. The data obtained from the experiments were extremely useful in the later plating of full scale 90 mm chrome plating anodes (Fig. 3).

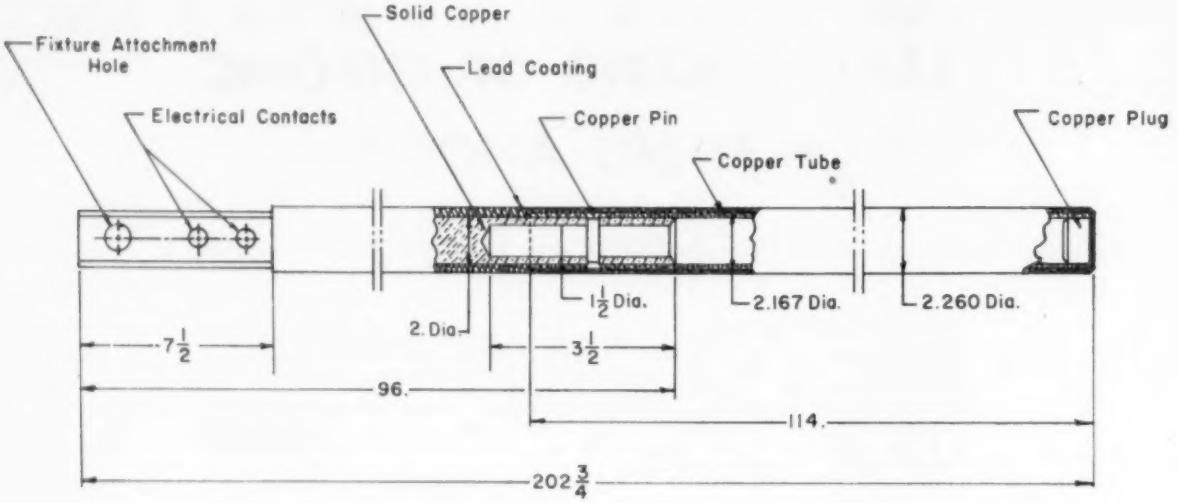


Fig. 1. Expermental lead burned anode for bore plating of 90 mm gun tubes.

B. First Full Scale Procedure

A steel tank (21 ft long, 7.5 in. O.D., 6.5 in. I.D.) was fabricated and installed vertically. The base of the tank was a chrome-plated steel plate. No attempt was made to prevent anodic corrosion, as this was only experimental and the desired life of the tank not an important consideration. A 50 per cent lead fluoborate solution served as the electrolyte. Using 175 amp current, two lead-burned 90 mm anodes were deplated and the lead deposited onto the inside walls of the tank. By reversing the current, it was possible to lead plate the copper core of one of the deplated anodes to a thickness of 0.125 in. This first full scale experiment was completed in October 1957. Fig. 4 shows the set-up for lead plating the anode. (Note the tank in right hand corner.)

This completed anode was used successfully to chrome plate one 90 mm gun tube. A second attempt to plate a 90 mm tube failed, due to the poor bond between the lead plate and the copper at certain points. An attempt was made to correct the anode by melting away the lead from the damaged area and reapplying the lead by the lead burning process. This procedure did not prove satisfactory as subsequent effort to chrome plate another tube failed. Concentration was directed to the development of a better process for lead plating.

Fig. 2.

C. Second Full Scale Procedure

A stainless steel tank (19 ft long, 7 in. O.D., 6.5 in. I.D.) was installed in a vertical position. A chemically pure lead sleeve (18 ft long, 6.375 in. O.D., and 5.5 in. I.D.) which serves as a consumable anode was inserted into the tank. The electrolyte used was a 50 per cent lead fluoborate solution containing 2 per cent of additives.* A cap which served as a centering device for the copper was placed on the tank.

To eliminate the need for a joint, as required in previous chrome plating anodes, a single section, round copper bar, 17.5 ft long with 2 in. O.D. was the cathode in the lead plating. A one and one-half inch diameter hole was drilled in the copper to a depth of 7 ft, to approximate the effect of the copper tubing previously used. However, the need for a hollow section is doubtful, as a second anode was plated with only a 4 ft hole, with comparable results.

Prior to plating, the copper was degreased with Savasol and lightly etched with dilute muriatic acid to remove any oxide film. After polishing with pumice it was connected to the negative electrical connection and lowered into the electrolyte to the proper depth (16 ft 10 in.). The positive electrical connection was made to the lead sleeve through the copper hooks which also serve as a lifting device. An exhaust system, consisting simply of flexible tubing connected to a lip vent for withdrawing any lead oxide fumes from the tank, was installed. Fig. 5 details the set-up for preparing the anode for chrome plating.

Early difficulty was encountered in determining the optimum plating current. One chrome-plating anode was lead plated using 80 amp current (i.e., cathode current density of 10 amp/sq ft). No agitation of solution was used. The plating obtained was not entirely satisfactory because considerable treeing was encountered.

Before attempting to lead plate a second anode, a system

* L61 and L62, products of Harshaw Chemical Company.

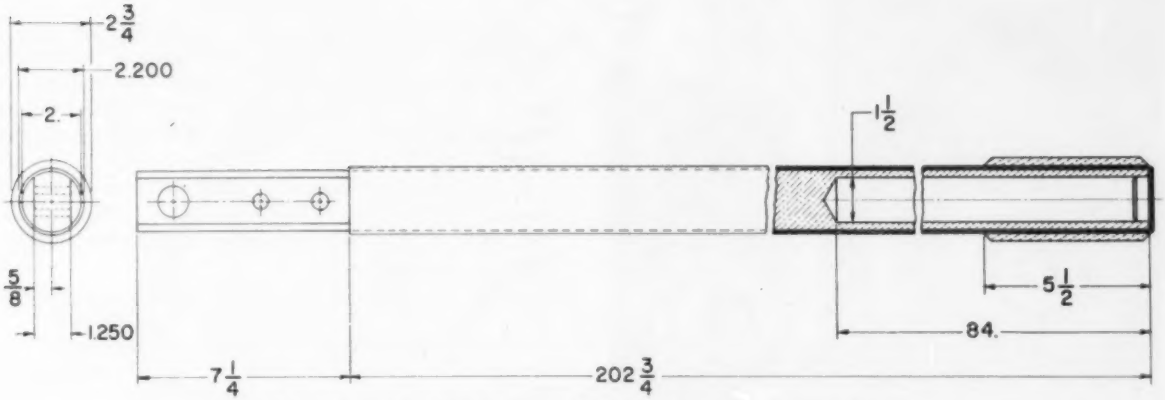


Fig. 3. Experimental lead plates anode for bore plating of 9 mm gun tubes.

whereby air is passed through the solution from bottom to top was installed, the volume of air being adjusted to slightly agitate the solution. The purpose of this system was to remove any gas which might adhere to the surface and cause pitting. A second chrome plating anode was lead plated using 48 amp current (i.e., 6 amp/sq ft current density). These conditions proved satisfactory, producing only slight treeing.

Periodic checks were made during each of the lead plating experiments to determine the amount of lead deposited and to examine for defects. After plating anode No. 1 for 127 hours, a deposit of 0.215 in. of lead on the diameter was obtained. Anode No. 2 required 157 hours to obtain the same thickness of deposit.

The lower amp-hour/inch thickness for the lower current density may be explained on the basis that much of the higher current was used for the formation of the trees; whereas, with the lower current density, a much lower degree of treeing was encountered, resulting in increased efficiency of deposition.

When treeing was observed during the periodic checks performed, they were scraped off with a knife or steel wool, care being exerted to avoid contaminating the lead surface. To eliminate the cause of treeing, the current density was reduced.

PLATING ANODES

Current Used	Cathode Current Density	Effects
Anode 1. 80 amp	10 amp/sq ft	Some treeing
Anode 2. 48 amp	6 amp/sq ft	Slight treeing

	Plating Time	Deposit
Anode 1.	127 hr	0.215 in.
Anode 2.	157 hr	0.215 in.

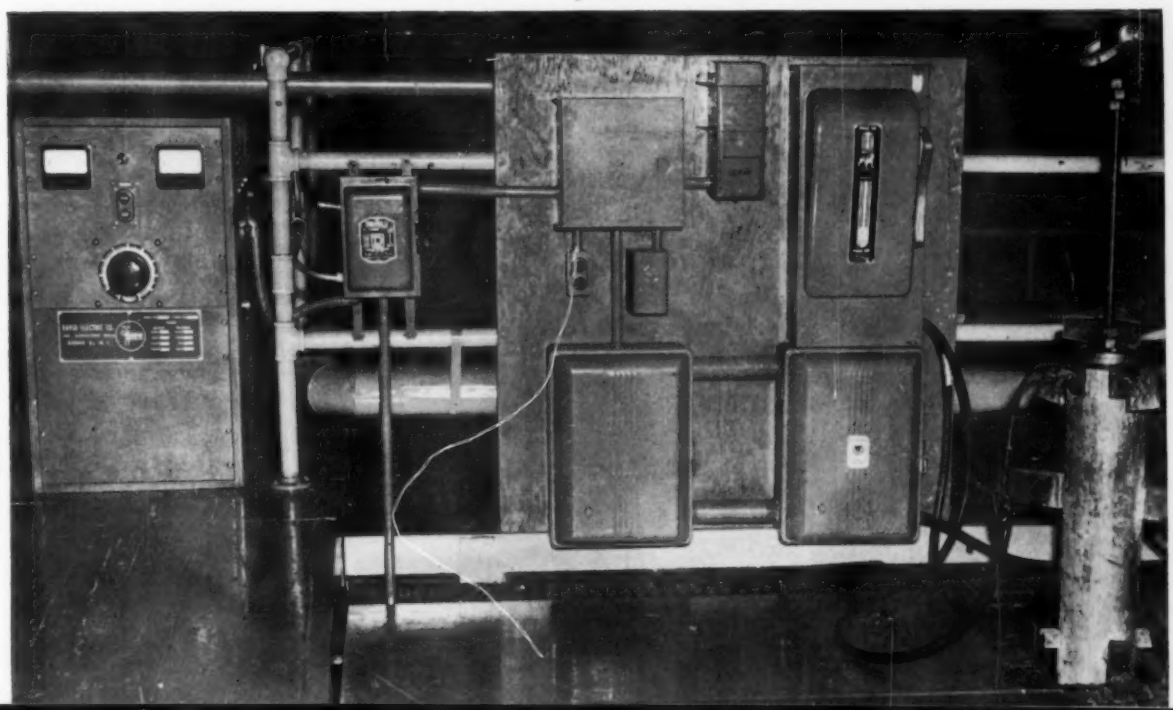
NOTE: Improved plate on anode 2 compensated for additional time.

RESULTS

1. Both lead plated anodes are now being used to chrome plate the bore of 90 mm gun tubes. The taper obtained on the chrome plating from breech to muzzle end has been slight as compared to that of the previous anodes. No repair has been necessary.

2. A comparison between the costs of "plating" and "lead burning" an anode show the former to be less than one-third

Fig. 4.



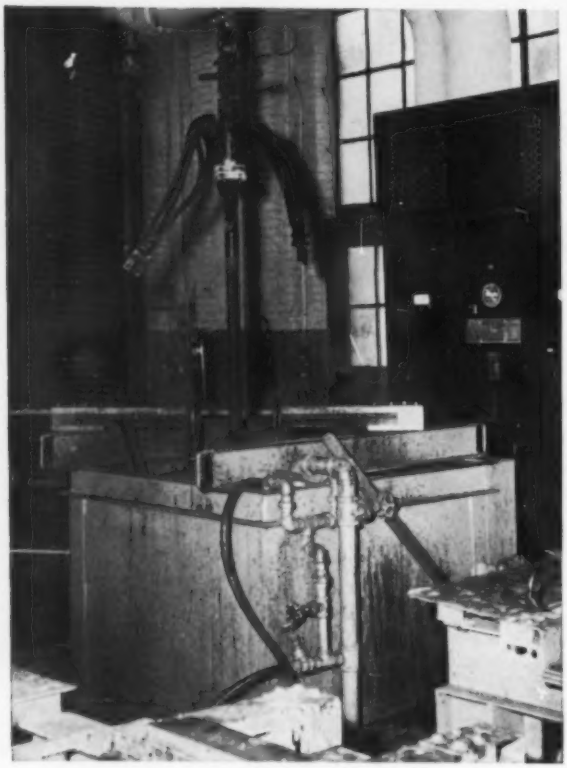


Fig. 5.

the price of the latter. A purchased "lead burned" anode costs approximately $1500; whereas an anode can be plated for approximately $415.

3. In the past, "lead-burned" anodes would plate approximately 10–15 gun tubes before requiring costly and slow repair. Anode No. 1 has plated over 200 gun tubes to date and anode No. 2, over 170 gun tubes. Neither have required any repair. This is due to the much better bond between the lead and the copper caused by the plating, and by the electrolytically pure homogeneous deposit, free of gas porosity.

4. In addition to the more tangible savings, a safety hazard has been eliminated. "Lead burning" emits large amounts of lead fumes which are very toxic. This condition is not present in the lead plating process. Also, there is no fire hazard as is the case where the torch is used to melt the lead.

COST COMPARISON

Purchase Price	Repair Cost /100 Tubes	Total Cost /100 Tubes
Lead burned anode $1500.00	+ $350.00	$1850.00
Plated anode $ 415.00		$ 415.00
Savings/100 tubes		$1435.00

EFFICIENCY OF ANODES

	No. of Guns Plated per Anode
Lead burned anode	12–15 tubes
Lead plated anode 1	200 tubes to date
Lead plated anode 2	170 tubes to date

NOTE: No repair to anodes 1 and 2 required.

CONCLUSIONS

1. The cost of lead plating 90 mm chrome bore-plating anodes will save approximately $1000/anode in initial cost.

2. A savings will be realized in repair required on the anodes. The "lead burned" type required repair, in the range of $100–$500, after an average of 10–15 tubes chrome plated.

3. An inestimable amount of savings will be realized in safety. The fumes created in "lead burning" are excessive and toxic, whereas with lead plating at room temperature, fumes are practically nil.

4. The lead plated anodes are decidedly better in performance. A maximum taper of 0.002 in. in chromium plate over the length of a 90 mm gun tube is realized as compared to an average of 0.003+ in. taper with the "lead burned" anode. Thus, chances for rejection of a chrome plated tube are considerably less. The cost of stripping and replating the chromium in a 90 mm tube is approximately $65.

5. Because of the increased anode life with a subsequent reduction in down-time caused by necessity for repair and the anode, production can be increased.

Lieutenant Francis A. Heiser is a native of Bethlehem, Pa., and is a 1956 graduate of Lehigh University, where he received a BS in metallurgy. He was employed as a metallurgist in the home plant of Bethlehem Steel until he entered the Army in November 1956.

Prior to his assignment at Watervliet Arsenal in April 1957, Lt. Heiser completed courses in the Officers Ordnance Training School, Aberdeen Proving Ground, Md. At the Arsenal he has been a Project Officer in the Manufacturing Branch and, presently, is assigned to the Operations Engineering Branch.

James E. Hyde joined the Watervliet Arsenal, Watervliet, N. Y., in 1939 as a toolmaker. From 1945 to 1949 he was with several Connecticut firms in the capacity of diemaker. He returned to the Arsenal in 1949 and in 1956 was made production planner at the Operations Engineering Branch. Prior to his first connection with the Arsenal, he was a toolmaker with Remington-Rand, Ilion, N. Y. Mr. Hyde is a member of the American Society of Tool Engineers, American Ordnance Association and Watervliet Arsenal Society of Engineers.

Speed

Diamond CPA 1800 speeds up chrome-plating time!

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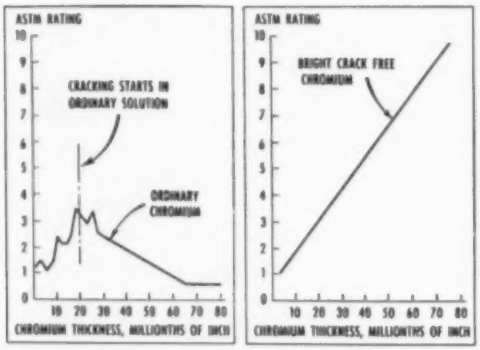
News about COATINGS FOR METALS

from Metal & Thermit Corporation

Thicker chromium plate increases corrosion protection

Thicker chromium in general, and Unichrome SRHS® and Crack-Free deposits especially, are doing more to increase protection against corrosion than any other change in decorative chromium plating in the past 25 years. Latest research demonstrates this.

As far back as 1928, it was shown that ordinary chromium plate soon reaches a critical thickness. (See graph A.) At a thickness of approximately .020 mils, the chromium cracks microscopically. Through these openings, corrosives can reach the



Graph A. Effect of increasing thickness of ordinary chromium on salt spray resistance . . . from Baker & Pinner data, SAE 1928. **Graph B.** Crack-Free Chromium ASTM corrosion ratings based on accelerated acetic acid salt spray tests.

undercoatings, and ultimately attack the base metal, ruining the appearance and function of the plated part.

Note, however, that before cracking commences, corrosion resistance *does* build up as the number of pores in the plate are reduced by the thicker deposit. Depending on undercoats, the effect of cracking can be modified.

DUCTILE CHROMIUM DOESN'T CRACK

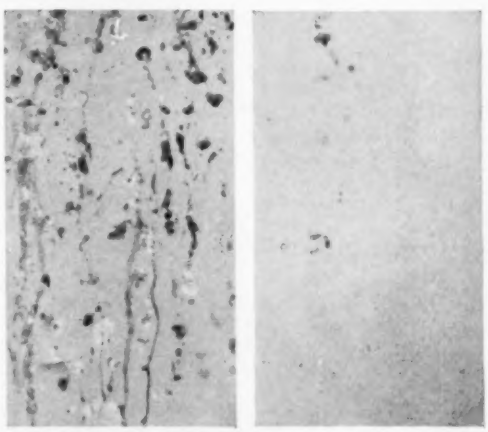
But see what happens in the case of Unichrome Bright Crack-Free Chromium. (Graph B.) An innovation in plating, it plates as thick as desired for practical purposes – entirely without cracks – and, as thickness increases, corrosion-admitting pores are eliminated. Protection keeps rising.

BETTER PROTECTION IN RECESSES

In the past, corrosion usually appeared in recessed areas of parts where little or no chromium could be plated to protect the base metal. This problem, too, is solved by Unichrome Bright Crack-Free Chromium which gives much better coverage and throwing power than previous processes.

LOW COST

The corrosion protection of decorative chromium can be improved several ways. Unichrome Crack-Free Chromium can be used alone or in combination with other fast plating SRHS chromium processes. Combination of chromium deposits, impossible from a practical standpoint for 25 years, is now done commercially with SRHS and Crack-Free Chromium, thereby eliminating need for new, larger tanks and saving thousands of equipment dollars.



Effect of thickness of CRACK-FREE Chromium over thin undercoatings (0.4 mil Nickel on steel) after 48 hours CASS test. Left – 0.015 mil Chromium; right – 0.045 mil Chromium.

A technical paper, "Thicker Decorative Chromium for Better Corrosion Resistance" gives more details. Write for your copy. METAL & THERMIT Corporation, Rahway, New Jersey.

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Right photo courtesy of Products Finishing

GOLDEN JUBILEE TECHNICAL SESSION AND BANQUET OF AES DAYTON BRANCH

(LEFT) Speakers, left to right, Dr. Frederick A. Lowenheim, John P. Nichols, William K. Murray and Ezra A. Blount. (RIGHT) Some of the 500 members and guests at the banquet held at the Biltmore Hotel, Dayton.

GOLDEN JUBILEE CELEBRATED AT ROCKFORD BRANCH ANNUAL

The Rockford Branch met Saturday, March 7 at the Faust Hotel for its 17th Annual Educational Session and Banquet.

The session began at 10:00 a.m. with a word of welcome from Branch President Stuart Golding, followed with a plating exhibit showing Rockford area's many electroplating contributions to all fields of industry.

A six-man panel, with Ralph D. Wysong as moderator, presided over a lively informal discussion. Anodizing, passivating, buffing, chrome plating, cleaning, organic finishing and specifications were some of the subjects discussed. To quote Mr. Wysong, "I have never presided over a more interesting or informative session."

The afternoon session, with Clyde Kelly presiding, began at 1:30 p.m. with a paper by Walter L. Pinner of McGean Chemical Co., on "Results of Research Program Project No. 15." Dr. Edward B. Saubestre, assistant to research director, Enthone, Inc. then delivered a paper on "Cleaning Evaluation Studies." The final paper was given by Dr. Emery P. Miller, research director, Ransburg Electro-Coating Corp., "New Developments in Electro-Static Finishing."

The 10:00 a.m. workshop session, plus the excellent presentations in the afternoon session once again served to highlight the greatest asset of the AES—those who desire to learn meeting with those who are able to teach.

The friendly, cooperative atmosphere made this an excellent session for the GOLDEN JUBILEE year.

Approximately 300 people attended the dinner and evening's entertainment in the Grand Ballroom.

DAYTON BRANCH CONDUCTS PROCLAIMED GOLDEN JUBILEE EVENT

With March 7, 1958 proclaimed "American Electroplaters' Society GOLDEN JUBILEE Day in Dayton" by that municipality's Mayor R. William Patterson, AES's Dayton Branch observed the Society's FIFTIETH ANNIVERSARY with a GOLDEN JUBILEE Educational Sessions and Banquet at the Biltmore Hotel of that city that will long be remembered as one of the Branch's most outstanding events in its 46-year history. The banquet, the attendant commemorative program, floor show and dance turned out a record audience of over 500 Branch members and their families and guests.

Dayton's contribution to the Society's FIFTIETH ANNIVERSARY observance started with an Educational Session starring Dr. Frederick A. Lowenheim, Metal & Thermit Corp., discussing "Corrosion of Plating Finishes"; William K. Murray, Enthone, Inc., presenting "Stripping of Organic Coatings" and Ezra A. Blount, editor, *Products Finishing*, covering "Factors Affecting Job Plating Costs". Using for the first time the golden gavel presented to the Supreme Society by the Dixie Regional Group and Southeastern Branch at the recent Sixth Interim Meeting, National Executive Secretary John P. Nichols was the Honorary Chairman. The Session was programmed by Dayton's Educational Chairman Lawrence J. Hadlock.

A lavish reception jointly sponsored by fourteen suppliers preceded and followed the banquet and was a hit of the evening.

The brief commemorative program over which Branch President Jack V. Baker presided under the golden banner of the JUBILEE and at which John P. Nichols was the principal speaker was followed by a bill of entertainment arranged by Robert Ruleff that starred lovely Marion Spelman, TV vocal star among others. The gold covered printed program was another feature of the memorable Dayton GOLDEN JUBILEE Day. Perfume in gold colored paper boxes were the ladies' favors.

Branch First Vice President Bennie Cohen was the event's General Chairman aided by Second Vice President Byron Bowman as Co-chairman. Branch Treasurer Richard Wright headed ticket sales; able Branch Secretary Richard M. Clinehans handled general arrangements, and functional Committee Chairmen included James Shane (Tickets); Robert Ruleff (Entertainment); Robert Fisher (Program and Advertising); Duane Prosser (Favors) and L. A. Critchfield (Publicity). Present and functioning were Dayton Branch stalwarts Fred Bauch and Holle Luechauer.

Founded in 1913 and Host Branch of two AES National Conventions to date, the Dayton Branch has to now produced at least two AES National Presidents, namely Walter J. Fraine (1917–1919) and Clarence L. Van Derau (1932–1934). Messrs. Fraine and Van Derau, in fact, were two of the only three National Presidents ever to serve two successive terms other than NEPA Founder-President Charles Henry Proctor.

MORNING SESSION of ROCKFORD BRANCH'S SEVENTEENTH ANNUAL EDUCATIONAL MEETING

AES National First Vice President Ralph D. Wysong, standing, moderator of the workshop session at Rockford on March 7. Rockford area plating exhibit in the left background.

AES NEWS

APRIL STARS FIVE MAJOR BRANCH AND REGIONAL ANNUAL MEETINGS

Three large regional GOLDEN JUBILEE events and two large Branch Anniversary affairs feature April.

With the Cincinnati, Columbus, Indianapolis, Dayton and Louisville Branches participating and the Louisville Branch as Host, the Fifth Tri-State Regional Educational Sessions and Banquet will be held in Louisville, Saturday, April 4.

At the Peter Stuyvesant Hotel in Buffalo on April 11, just a week later, the Buffalo, Capitol District, Mohawk Valley, Rochester, Southern Tier and Syracuse Branches will collaborate to conduct the vaunted annual Empire State Regional event with the Buffalo Branch as Host. And in Washington, that same week-end the Baltimore-Washington Branch will be conducting its heralded FIFTIETH ANNIVERSARY commemorative.

The third April Saturday, April 18, will find the patriarch of all AES regional groups, namely the New England Regional conducting its Twentieth Regional Educational Sessions and Banquet at the Hotel Statler, Hartford, Connecticut, with the Waterbury Branch as Host. Participating in making this another outstanding New England annual event will be the Bridgeport, Hartford, New Haven and Springfield Branches, beside the host Waterbury Branch.

The famed annual party of the Milwaukee Branch will be the last of the April galaxy. Occurring on April 25, the Milwaukee Annual Meeting and Banquet will be held at the Schroeder Hotel of that municipality. It will feature an Educational Session, a traditional luncheon, then a banquet and dance. An additional attraction will be the forenoon business meeting of the Midwest Regional Council recently finalized, the group that will host the 1962 Annual Convention in Milwaukee. The Chicago, Rockford, Mississippi Valley, St. Joseph Valley, St. Louis and Milwaukee Branches compose it.

And racing to the fore when April turns to May will be Boston Branch's Twenty-Third Annual Technical Session and Banquet that will be held in that venerable community's Statler Hotel, Saturday, May 2.

GOLDEN JUBILEE COMMEMORATIVE TO FEATURE BALTIMORE-WASHINGTON ANNUAL MEETING

PACKED with novelties, features and attractions, the GOLDEN JUBILEE observance of the Baltimore-Washington Branch will be held at the Statler Hotel, Washington, D. C., Saturday, April 11, 1959 with a record attendance anticipated. Combining a star-studded educational program in the afternoon and an evening's ingenious FIFTIETH ANNIVERSARY commemorative program, banquet and dance, the event in the nation's capital is primed to become one of the banner events of the GOLDEN JUBILEE.

With Dr. William Blum, first AES Scientific Achievement Award winner, himself presiding, the afternoon's Educational Sessions will headline such experts as Dr. Abner Brenner, National Bureau of Standards; Dr. W. Andrew Wesley, International Nickel Company and John G. Beach, Battelle Memorial Institute.

The outstanding evening program created by General Chairman Arthur G. Pierdon who will be remembered as chairman of the AES's 43rd Annual Convention held in Washington in 1956 will feature a commemorative to the birth, a half-century ago, of the National Electro-Platers Association of the United States and Canada (NEPA) that was transformed into today's AES in 1913. Two charter members of NEPA, namely Justus A. Stremel of the New York "Mother" Branch and F. F. Pierdon, now of the Baltimore-Washington Branch, will be honored and will speak. Mr. Stremel will briefly reminisce concerning the beginnings of today's Society, and Mr. Pierdon will discuss "Plating Fifty Years Ago".

Under the golden banner of the GOLDEN JUBILEE, moreover, National President Herberth E. Head will receive the traditional "pot" of the Order of Past Presidents, gold-plated this year, however, in keeping with the GOLDEN JUBILEE. It is expected that a number of Past Presidents will be present to participate in the colorful ceremony originated in 1946 by Past President Kenneth M. Huston of the Baltimore-Washington Branch, and now a cherished AES tradition of that Branch. The evening's principal speaker will be Dr. Hugh L. Dryden, Deputy Administrator of the National Bureau of Aeronautics, and he will present, "Some Problems of the Space Age."

The Executive Board will convene in regular session on Friday, April 10 and will adjourn by noon on Saturday, April 11. All National Officers will be honored guests of the Branch at the Banquet, together with officials of the Metal Finishing Suppliers' Association, National Association of Metal Finishers, the New York "Mother" Branch and others.

FIRST AWARD OF "POT" OF ORDER OF PAST PRESIDENTS
Present when Past President Walter L. Pinner received the first traditional "pot" of the Order of Past Presidents at Maryland Yacht Club in Baltimore in April 1946 were (left to right) George Gehling; Dr. William Blum; Kenneth M. Huston; Frank J. Mesle; Mr. Pinner; Frederick Fulforth; Dr. A. Kenneth Graham and Thomas F. Slattery.

PROGRAM ANNOUNCED FOR MILWAUKEE JUBILEE ANNUAL

The Schroeder Hotel in Milwaukee will be the scene on April 25 of the Golden Jubilee Meeting and Banquet of the AES Milwaukee Branch.

Three speakers have been obtained for the 1:30 p.m. technical session. Dr. W. Andrew Wesley, International Nickel Co. and AES National Second Vice President, will deliver a paper on "Weathering Behavior of Nickel-Chromium Coatings." Dr. Richard B. Saltonstall of The Udylite Corp. will speak on "The Role of Agitation in Electroplating" and "Emulsion Coatings for Industrial Applications" will be presented by Alex Undreoni of The Glidden Co.

Tickets for the luncheon at 11:45 a.m. are available at $3.50. The banquet in the evening will include entertainment by the Obert-Anthony Orchestra and Chorus, a company of 40 people.

NEWARK BRANCH GRADUATES 33 ELECTROPLATING STUDENTS

Diplomas were awarded to the graduates of the 1958–59 Newark Branch sponsored electroplating course at the February meeting of the Branch. (FRONT ROW) Instructors and Committee: M. Di Chiara, E. C. Rinker, D. S. Carr, J. C. Kosmos, G. Bittrich, F. J. La Manna, D. G. Foulke, A. Korbelak. (SECOND ROW) M. Ross (proxy for J. Tomick), A. Atwater (proxy for B. Gruber), R. Colish, J. Marcelli, A. T. Chasmer, C. T. Bird, C. Tringali, E. B. Kopetz, N. Lauterette, C. Stellaci, J. Connell, D. N. Mulder, R. Moyes, F. Kelly, J. Beam, E. Yambor, J. Comandini. (THIRD ROW) T. Barreiro, D. Ward, G. Shaw, S. Bifano, G. J. Cota, C. Van Sickle, S. Messina, L. Botkin, F. J. Eiden, R. J. Isak, S. A. Dral. (Others not present) H. S. Allison, R. C. Morrison, R. G. Pierson, R. J. Pizzarelli, T. Wilczek. The story of the Newark and other Branch schools will appear in the May issue.

Edward W. T. Faint

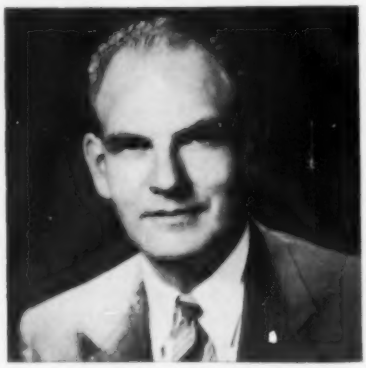
FAINT ANOTHER OF AES'S LIVING FOUNDING FATHERS

A fifth stalwart in the quintuplet of living Founding Fathers of AES that includes Justus A. Stremel, Harry C. Bernard, William Schneider and F. F. Pierdon is Edward W. T. Faint, now living in Short Hills, New Jersey and currently a member of the Newark Branch.

A native of London, England, Mr. Faint came to the United States with his parents in July 1880 and was educated in the schools of Elizabeth, N. J. and later at Cooper Union, New York.

Entering the electroplating field in its infancy, he rose to the position of Foreman in charge of the Plating Department of Singer's Manufacturing Company in 1890, and served as such to 1925. Until his retirement in 1946, he was thereafter Foreman of the Polishing & Plating Department of the Mack Truck Corporation of Allentown, Pennsylvania.

Hale, hearty and vigorous, Mr. Faint, an AES Charter Member and an early Newark Branch President, is still a dedicated and reasonably active member of the Society.



Arthur G. Pierdon
Baltimore-Washington Branch

PIERDON ANNOUNCED AS VICE PRESIDENTIAL CANDIDATE

The candidacy of Arthur G. Pierdon (Baltimore-Washington Branch) for AES Third Vice President was announced at the Sixth Interim Meeting of the Supreme Society held in Atlanta, Georgia, February 14, 1959 by E. E. Oberland, a Delegate of that Branch. Mr. Pierdon is President of the Art Metal Finishing Company of Washington, D. C., an enterprise created in 1923 by his father, Frederick F. Pierdon, himself a founding father of AES and still active in the Baltimore-Washington Branch.

A native of Washington, Arthur Pierdon offers a strong background of AES service. He is a Charter Member of his Branch and headed it in 1932 and 1935. He served as General Chairman of the AES's 43rd Annual Convention held in Washington in 1956. His other affiliations include the Electrochemical Society, the Washington Board of Trade, the Greater Washington Industrial Council and National Association of Metal Finishers of which he is a Director. Married to the former Mary H. Armstrong, he has six children and four grandchildren.

Robert Dudley
Outing Chairman

GOLDEN JUBILEE OUTING HEAD REPORTS TO YOU . . .

"Starting at 4:00 p.m. Wednesday, June 17 will be your chance in a lifetime to be a MILLIONAIRE FOR FREE. Under the big tent at the GOLDEN JUBILEE Outing, you can go around with $50,000 bills in your hands! Your pockets will be stuffed with money! And ladies, bring your large handbags—you'll need them.

"You can gamble thousands of dollars as you please and win valuable prizes, including a portable TV set and many other attractive, worthwhile gifts. Show your skill at Race Horse, Big 6, Roulette, Klondike, Chuck-a-Luck, Razzle Dazzle, etc. and maybe Lady Luck will be with you.

"And after you have gambled your stage money, then at 6:00 p.m., you will participate in an old fashioned OX ROAST BARBECUE with all the trimmings. Can you smell that tempting aroma right now? So come and get it at the Artillery Armory's grounds, in Oak Park, Michigan, June 17, 1959—Wednesday at four."

SUPREME SOCIETY PARTICIPATES IN OUTSTANDING GOLDEN JUBILEE EVENT

With a record crowd present despite conditions that prevented many more from attending, Dixie's GOLDEN JUBILEE Educational Sessions and Banquet, concurrent with the Sixth Interim Meeting of the Supreme Society, was held at the Dinkler-Plaza Hotel in Atlanta, Georgia, February 13–14, 1959, and was pronounced an outstanding success. Those days were veritably "American Electroplaters' Society GOLDEN JUBILEE Days in Atlanta" as proclaimed by Mayor W. B. Hartsfield.

Under the golden flags of the Jubilee, the Opening Session launched the event, though earlier that first eventful day, a sizable audience had attended the plant tour of the Georgia Division of the Lockheed Aircraft Corporation in nearby Marietta. General Chairman M. M. Randman presided over the brief opening ceremonies and welcomed AES to Dixie. National President Herberth E. Head responded for the Society.

Two Educational Sessions featured the GOLDEN JUBILEE event in our Southland. Programmed by Educational Sessions Chairman Jerita D. Wilson, the sessions brought together four noted speakers including Dr. Harold J. Wiesner, Bendix Aviation Corp., R. T. Gore, Metal & Thermit Corp., Dr. Abner Brenner, National Bureau of Standards and James D. Thomas, General Motors Corp.

AES's Executive Board engaged in a full-day's meeting Friday, then met in joint informal session with the Board of Trustees of the Metal Finishing Suppliers' Association that same Friday evening.

Society's Governors Transact Much Business

Welcomed in behalf of the Dixie Regional Group and the Southeastern Branch by AES Past President Frederick Fulforth, the Supreme Society held its full-day meeting Saturday, with National President Head in the chair.

The Sixth Interim Meeting had a thorough review of AES affairs from the reports of the six National Officers. Moreover, it heard the Society's various programs discussed by their respective Chairmen or representatives, including Chairman Manuel Ben (Membership), Vice Chairmen Kergan Wells and James D. Thomas (Research), R. Scott Modjeska (Publications), others. Wright W. Wilson reported for the "Appraisal Committee as to the Need for a Convention Planning Committee", and Ezra A. Blount spoke for the "Appraisal Committee as to the Need and Duties of a Long-Range Planning Committee".

From Exposition Chairman Howard J. McAleer, the meeting heard the glowing record to date of the Fifth Industrial Finishing Exposition to be held in Detroit in June some 80 per cent of whose exhibit space has already been sold to some 130 exhibitors. And from General Convention Chairman Wright W. Wilson, it heard the elaborate plans of the GOLDEN JUBILEE CONVENTION. John P. Nichols reported on the thriving year-long GOLDEN JUBILEE observance, and also reported on the Fifth International Conference on Electrodeposition and Metal Finishing educational program created by Chairman Walter L. Pinner and his Anglo-American Committee under the supervision of the Editorial Board.

The Society's per capita tax structure came under the Supreme Society's scrutiny, and Delegates also took careful measure of the need to stimulate Sustaining Memberships simultaneously with the AES's current Jubilee effort to increase Branch memberships by a minimum of twelve acceptable additional members per-Branch by July 1, 1959 over and beyond members newly elected during the period from July 1, 1958 and December 31, 1958. The Philadelphia Branch entered its documented invitation to host the Seventh Interim Meeting as springboard of its own FIFTIETH ANNIVERSARY in 1960, and also asked for the 1965 Annual Convention. The New York "Mother" Branch and the Dallas-Fort Worth Branch also entered invitations for the 1965 Convention. The candidacy of Arthur G. Pierdon for the AES Third Vice Presidency was announced by E. E. Oberland of the Baltimore-Washington Branch.

Business transacted by the Supreme Society by "sense of the meeting" resolution included, a) the proposal to amend the AES Bylaws to provide for a September 1 per capita tax due-date instead of December 1, b) a $10 per capita tax effective in 1959–1960 instead of the $5.70 prevalent since 1946, c) reaffirmation of the exclusive authority of the Executive Board to bestow Awards of Merit, d) proposal that the Supreme Society name the place and date of Interim Meetings at least two years in advance, e) the proposal that Annual Meeting Minutes be issued to each accredited Delegate, plus a file and record copy sent to each Branch Secretary, thus reducing the number of copies of the sizable book thus issued from eight as now to four.

Delegates Alternates were the guests at luncheon of the Dixie Region and Southeastern Branch. Through AES Past President Frederick Fulforth, indefatigable Interim Meeting Coordinator, the region and the Branch were highly commended by the Society's Governors for an outstanding job done for AES.

Gold Gavel Presented To Supreme Society

A noteworthy Reception, followed by a sumptuous Banquet, ended the GOLDEN JUBILEE's midwinter event in the realm of King Cotton. During the brief program, a gold-plated gavel was presented to the Executive Board for its use through the years as a memento of the devotion of the Dixie Region and Southeastern Branch. Branch President Claude J. Nalley made the presentation. National President Head accepted in behalf of the Society. Clyde Stovall and H. R. Stogner Sr. were fathers of the idea. A floor show, then dancing, concluded the evening's pleasure.

Beside Southeastern Branch President Nalley, other Dixie Region leaders present and participating were Blue Ridge Branch President T. R. Boggess and Miami Branch President Marmaduke H. Dent. Other stalwarts who assisted in making the event so successful were Justus U. Belville (Entertainment); Herbert W. Hatley (Hotel and Banquet); Charles I. Lewis (Plant Visitation); John E. Varner (Program); William F. Kelly (Publicity); Richard R. Russell (Registration) and Jim Hall, Harry Pink and Clem Hohner (Welcome). The golden printed program of the event was one of the finest yet seen during AES's GOLDEN JUBILEE.

AES's Golden Jubilee Gavel from Dixie

5TH ANNUAL EMPIRE STATE REGIONAL MEETING

Participating Branches:
Rochester, Syracuse, Southern Tier, Capitol District and Mohawk Valley

Hotel Peter Stuyvesant, Buffalo, N. Y.

Saturday, April 11

2 p.m.—EDUCATIONAL SESSIONS

Speakers:
Plating:
I. Laird Newall, Souther Engineering Co.
Manuel Ben, General Motors Corp.
Organic Finishing:
Fremont L. Scott, Metal & Thermit Corp.
Everett W. Linton, Duralac Chemical Corp.
Joint Meeting:
Alcoa Motion Picture

1:30 p.m.—LADIES LUNCHEON & FLORAL DEMONSTRATION

7:30 p.m.—BANQUET—DANCING

PROPOSED CHANGES IN THE AES CONSTITUTION

(Notice in Conformity with Part III, Article I, Section 3 of AES Constitution)

Approved by the Executive Board as certified by the Law Committee, the following AES Constitutional (and Bylaw) amendments will be considered and acted upon by the Supreme Society, AES's summit government, at its Annual Meeting to be held at the GOLDEN JUBILEE Convention, Detroit, Michigan, Thursday, June 18, 1959.

CONSTITUTION

PART I, ARTICLE IV, SECTION 1:

Last sentence now reads, "All other officers of the Society shall be elected." Change to read, "All other officers of the Society except the Past President shall be elected." *NOTE:* The Immediate Past President is automatically an officer of the Society during the year following his tenure as President (Part I, Article IV, Section 5).

PART I, ARTICLE V, SECTION 2:

Add at the end of the paragraph: ". . . (e) Honorary Members shall be exempt from the payment of dues."

PART I, ARTICLE V, SECTION 2:

Now reads, "The minimum annual dues of Active Members shall be eight dollars ($8.00) plus one dollar ($1.00) which shall be used to support research." Change $8.00 to $9.00. *NOTE:* The Sixth Interim Meeting of the Supreme Society adopted a "sense of the meeting" resolution, February 14, 1959 in Atlanta, Georgia, proposing a per capita tax increase from $5.70 to $10.00 effective July 1, 1959. The foregoing proposed amendment enables Branches to charge whatever amount of annual dues they please beyond the $10.00 Per Capita Tax payable to the Supreme Society annually if this Amendment is enacted.

PART I, ARTICLE V, SECTION 3:

Now reads, "From the annual dues of each Active and Sustaining Member, there shall be paid to the Supreme Society, a Per Capita Tax of five dollars and seventy cents ($5.70), two dollars ($2.00) of which shall be used to pay the annual subscription to the official journal of the Society and one dollar ($1.00) of which shall be paid into the Research Fund." Change $5.70 to $10.00. *NOTE:* Five Branches, namely Baltimore-Washington, Boston, Columbus, Grand Rapids and St. Joseph Valley have invoked the initiative provisions of the Constitution and have officially championed a Per Capita Tax increase from $5.70 to $10.00 effective July 1, 1959 as proposed by the Sixth Interim Meeting.

PART I, ARTICLE VIII, SECTION 3:

Now reads, "Minutes of each meeting of the Supreme Society shall be sent to each Delegate and Alternate and each Branch President and Branch Secretary." Change to read, "Minutes of each meeting of the Supreme Society shall be sent to each Delegate and to each Branch Secretary, the latter copy to be preserved as the Branch's file copy." *NOTE:* In the interest of economy, this will reduce the number of copies issued to each Branch from eight to four.

BYLAWS

PART I, ARTICLE III, SECTION 14:

Delete the entire Section. See substitute therefor in Part I, Article VI, Section 8 that follows.

PART I, ARTICLE V, SECTION 2:

Now reads, "Suspensions: A member for whom Per Capita Tax has not been paid on December 1 for the fiscal year beginning July 1 of the same calendar year shall be considered suspended until said tax shall be paid and shall not receive the official journal or other publications of the Society during suspension." Change December 1 to September 1.

PART I, ARTICLE V, SECTION 3:

Now reads, "Per Capita Tax: A Per Capita Tax of five dollars and seventy cents ($5.70) per annum for each member in good standing shall be paid by each Branch out of the members' dues. The tax shall be paid annually, not later than the first day of December; except that for each new member of a Branch there shall be paid upon his election, a tax proportionate to the number of complete quarters remaining of the fiscal year. If a Branch tax remains unpaid after thirty days from due-date, Executive Secretary shall demand payment in writing, and if the tax remains unpaid after the thirty days following such demand, the Branch shall be considered not in good standing and its members shall not receive any benefits or publications of the Society until the said tax is paid. A Branch whose tax for any fiscal year shall remain unpaid thirty days after the beginning of the following fiscal year may, by action of the Executive Board, be suspended, and persistent failure to pay shall be grounds for revoking a Branch Charter by the Supreme Society." Change $5.70 to $10.00. Change December to September.

NOTE: AES Per Capita Taxes have remained at present level since 1946 despite the large assaults of inflation. Due 1) to advertising decreases resulting from general business recession and 2) to swelling operating costs resulting from said generally upward spiralling inflation, the proposed Per Capita Tax increase was recommended by the Sixth Interim Meeting of the Supreme Society held in Atlanta, Georgia, February 14, 1959. The December 1 to September 1 due-date change is proposed so as to enable PLATING MAGAZINE, under AES's new fiscal year, effectively to comply with the rules and regulations of the Audit Bureau of Circulations, a change proposed by a "sense of the meeting" resolution also adopted at the Sixth Interim Meeting of the Supreme Society held in Atlanta, February 14, 1959.

PART I, ARTICLE VI, SECTION 8:

Your Constitution and Bylaw booklet (a/o 4/1/58) now reads: "Exhibits of manufacturers' products may be held at the discretion and under the direction of the Executive Board." This section was amended by the Supreme Society (5/28/58) to read, "The Executive Board may at its discretion recommend to the Convention the date and place of an exhibit of manufacturers' products and of the accompanying Annual Convention." It is now proposed to add thereto, "At any Annual Convention, exhibits by Branches or individual members of the Society may be invited or authorized at the discretion and under the direction of the Executive Board."

PART I, ARTICLE VI, SECTION 9:

Now reads: "Interim Meetings: There shall be an annual Interim Meeting of the Supreme Society, at a time and place selected by the Supreme Society at the next previous Annual Meeting, for the purpose of hearing reports and proposals, of considering all matters referred to it by the Annual Meeting, and of making recommendations to the Annual Meeting and the Executive Board concerning these and other matters which may come before it. No action of any Interim Meeting shall be binding on the Society." Delete, ". . . at the next previous Annual Meeting . . ."

PART II, ARTICLE V, SECTION 5:

Paragraph No. 2 of that Section now reads: "Before the first day of December, the Treasurer shall remit to the Executive Secretary of the Society, the Per Capita Tax of $5.70 due for each member of the Branch; and he shall subsequently remit upon the election of a new member, a Per Capita Tax proportionate to the number of quarters remaining of the fiscal year. He shall remit to the Executive Secretary the proceeds of any duly levied Special Per Capita Tax." Change December to September and $5.70 to $10.00.

PART II, ARTICLE VIII, SECTION 1:

Now reads: "Amount: The minimum annual dues of Active Members shall be $9.00, etc." Change $9.00 to $10.00. This change will enable the Branch to charge any amount of annual dues to its members that it pleases beyond the Per Capita Tax ($10.00) due and payable to the Supreme Society annually if enacted.

INITIATIVE RESOLUTION

WHEREAS: The Per Capita Tax structure of AES, in contrast with those of other comparable technical societies, has not been altered in late years (thirteen) to meet even partially the advancing costs of service and operation; and
WHEREAS: it is evident that a material increase in Per Capita Tax is necessary, not only to maintain the present level of services to members, but actually to prevent deterioration of the Society's financial health; be it therefore
RESOLVED that the recommendation of the Sixth Interim Meeting held on February 14, 1959 at Atlanta, be adopted and that the Constitution and Bylaws be amended so as to increase the total Per Capita Tax to be paid the Society from $5.70 to $10.00 annually effective July 1, 1959.

Baltimore-Washington Branch
Boston Branch
Columbus Branch
Grand Rapids Branch
St. Joseph Valley Branch

TENTATIVE PROGRAM

GOLDEN JUBILEE CONVENTION AND INDUSTRIAL FINISHING EXPOSITION
AMERICAN ELECTROPLATERS' SOCIETY, INC.

HOTEL STATLER-HILTON, DETROIT, AND ARTILLERY ARMORY, OAK PARK, MICHIGAN

JUNE 15-19, 1959

This is a TENTATIVE PROGRAM as of March 1, 1959. Additions and modifications will be made monthly until finalized

SUNDAY, JUNE 14		
9:00 a.m.	Executive Board Meeting (All Day)	Hq. Room (Parlor B)
1:00–8:00 p.m.	Registration	Foyer
3:00–5:00 p.m.	Ladies Tea	English Room
4:00 p.m.	Credentials Committee Meeting	Parlor B
4:00 p.m.	AES Scientific Achievement Award Committee Meeting	Parlor F
8:00 p.m.	Golden Jubilee Get-Together Party	Grand Ballroom
MONDAY, JUNE 15		
9:00 a.m.–5:00 p.m.	Registration	Foyer
10:00 a.m.	Grand Opening, Golden Jubilee Convention	Grand Ballroom
11:00 a.m.	Business Meeting, Supreme Society	Grand Ballroom
12:00 noon	Branch Secretaries' Luncheon	English Room
12:00 noon	Speakers' Luncheon	Parlor E
12:00 noon	Ladies Program. Luncheon at Detroit Yacht Club. Special Entertainment	Bus from Statler-Hilton
2:00 p.m.	Opening Educational Session A, Fifth International Conference on Electrodeposition and Metal Finishing	Grand Ballroom
3:00 p.m.	Editorial Board Meeting	Parlor E
4:30 p.m.	Order of Past Presidents, Business Meeting	Parlor F
6:30 p.m.	Past Presidents' Dinner	English Room
7:00–9:00 p.m.	Registration	Foyer
9:00 p.m.	AES Golden Jubilee Open House (Sponsored by Metal Finishing Suppliers' Association)	Sheraton-Cadillac Ballroom
TUESDAY, JUNE 16		
8:00 a.m.	Research Committee Breakfast	Parlor F
8:00 a.m.	Speakers' Breakfast	(To be Announced)
9:00 a.m.–12:00 noon	Registration	Foyer
9:00 a.m.	Educational Session B, International Conference	Grand Ballroom
9:00 a.m.	Educational Session C, International Conference	Michigan Room
9:00 a.m.	Research Committee Meeting	Parlor F
9:00 a.m.	Educational Committee Meeting	Parlor E
9:30 a.m.	Plant Visit, Ford Motor Company (Rouge Plant), Dearborn, Michigan	Bus from Statler-Hilton
10:00 a.m.–9:00 p.m.	Industrial Finishing Exposition	Artillery Armory
11:00 a.m.	Ladies Program. Trip to Dearborn Inn—Luncheon and Entertainment, followed by Tour of Edison Institute and Greenfield Village	Bus from Statler-Hilton
12:00 noon	Branch Librarians' and Educational Committee Luncheon	English Room
12:00 noon	Speakers' Luncheon	(To be Announced)
2:00 p.m.	Opening Ceremony, Fifth Industrial Finishing Exposition	Artillery Armory
2:00 p.m.	Research Committee Meeting	Parlor F
2:30 p.m.	Educational Session D, International Conference	Artillery Armory
WEDNESDAY, JUNE 17		
8:00 a.m.	Membership Committee Breakfast	Parlor F
8:00 a.m.	Speakers' Breakfast	Parlor E
8:30 a.m.	Golden Jubilee Golf Tournament (Sponsored by the Metal Finishing Suppliers' Association)	Pine Lakes Country Club
8:45 a.m.	Ladies Program. Lake St. Clair Cruise on the S.S. Aquarama (Luncheon)	Bus from Statler-Hilton
9:00 a.m.–12:00 noon	Registration	Foyer
9:00 a.m.	Public Relations Committee Meeting	English Room
9:00 a.m.	Membership Committee Meeting	Parlor F
9:00 a.m.	Educational Session E, International Conference	Grand Ballroom
9:00 a.m.	Educational Session F, International Conference	Michigan Room
9:30 a.m. (Tentative)	Plant Visit, Chrysler Engineering Laboratory	Bus from Statler-Hilton
10:00 a.m.–9:00 p.m.	Industrial Finishing Exposition	Artillery Armory
4:00 p.m.	Golden Jubilee Outing (Millionaire's Party, followed by Barbecue)	Artillery Armory Grounds
THURSDAY, JUNE 18		
8:00 a.m.	Speakers' Breakfast	Parlor F
9:00 a.m.–12:00 noon	Registration	Foyer
9:00 a.m.	Business Meeting, Supreme Society	Wayne Room
9:00 a.m.	Educational Session G, International Conference	Grand Ballroom
9:00 a.m.	Plant Visit, General Motors Technical Center, Warren, Michigan	Bus from Statler-Hilton
10:00 a.m.–4:00 p.m.	Industrial Finishing Exposition	Artillery Armory
11:00 a.m. (Tentative)	Ladies Program. Brunch followed by Auto Styling Show at Chrysler Corporation and Tea	Bus to Chrysler from Statler-Hilton
12:00 noon	Speakers' Luncheon	Parlor F
2:00 p.m.	Business Meeting, Supreme Society	Wayne Room
2:30 p.m.	Educational Session H, International Conference	Grand Ballroom
7:00 p.m.	Golden Jubilee Banquet, Floor Show and Dance	Statler-Hilton

(Continued on the next page)

Artillery Armory, Site of AES's Industrial Finishing Exposition

(Tentative Program Continued From Previous Page)

GOLDEN JUBILEE CONVENTION AND INDUSTRIAL FINISHING EXPOSITION
AMERICAN ELECTROPLATERS' SOCIETY, INC.

FRIDAY, JUNE 19

8:00 a.m.	President's Breakfast (National Officers and Wives)	President's Suite
8:00 a.m.	Speakers' Breakfast	Parlor F
9:00 a.m.	Executive Board Meeting	Parlor B
9:00 a.m.	Educational Session I, International Conference	Michigan Room
9:00 a.m.	Educational Session J, International Conference	Grand Ballroom
10:00 a.m.–6:00 p.m.	Industrial Finishing Exposition	Artillery Armory
10:00 a.m. (Tentative)	Ladies Program. Ford Motor Company Tour	Bus from Statler-Hilton
12:00 noon	Speakers' Luncheon	Parlor F
2:30 p.m.	Educational Session K, International Conference	Artillery Armory

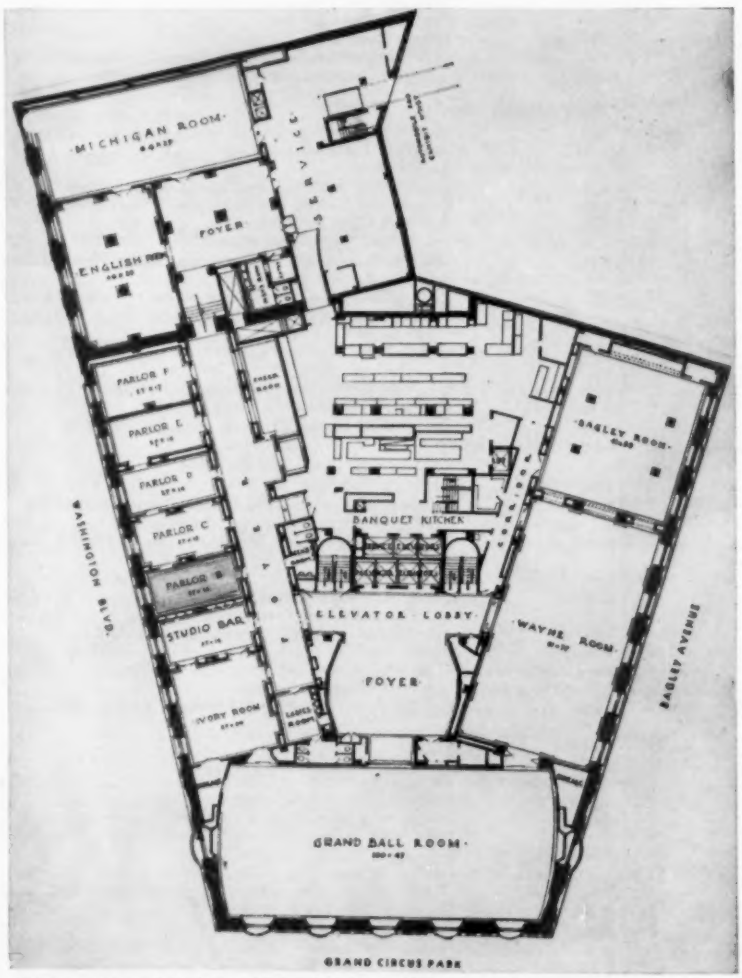
GOLDEN JUBILEE CONVENTION LOOMS AS AES's LARGEST ASSEMBLY

A fitting climax of the AES's FIFTIETH ANNIVERSARY, the GOLDEN JUBILEE Convention and Industrial Finishing Exposition, including the Fifth International Conference on Electrodeposition and Metal Finishing, to be held in Detroit, Michigan, June 15–19, 1959, loom larger and even more outstanding at this stage of their planning and development than ever anticipated.

Eleven educational sessions featuring the 45 papers of experts from ten countries will feature the AES's Fifth International Conference on Electrodeposition and Metal Finishing, educational sessions phase of the GOLDEN JUBILEE Convention.

Six outstanding Ladies events will spark a wonderful week for AES's mothers, wives and daughters. There will be tea and music on Sunday afternoon—luncheon at the Yacht Club on Monday—luncheon at Dearborn Inn and a tour of Greenfield Village and Edison Institute on Tuesday—a cruise on Lake St. Clair on the good ship, S. S. Aquarama, on Wednesday—a brunch followed by Chrysler's Automobile Styling Show and Tea on Thursday; followed by a tour of Ford on Friday.

The Industrial Finishing Exposition's progress to date is glowing. With space aggregate already expanded once, most of the nearly 36,000 square feet of now-available exhibit space has already been purchased by industrial companies so as to display their latest equipment and processes to the largest expected traffic in AES half-century history at the GOLDEN JUBILEE CONVENTION in Detroit, June 15–19, 1959.



Ballroom floor of the Statler-Hilton Hotel on which many of the convention activities will take place. Shaded area is AES Headquarters Room.

PROGRAM

INTERNATIONAL CONFERENCE

on

ELECTRODEPOSITION AND METAL FINISHING

THE EDUCATIONAL SESSIONS PHASE OF

GOLDEN JUBILEE CONVENTION, AMERICAN ELECTROPLATERS' SOCIETY

HOTEL STATLER-HILTON, DETROIT, and ARTILLERY ARMORY, OAK PARK, MICHIGAN

JUNE 15-19, 1959

MONDAY, JUNE 15

2:00 p.m. Educational Session ..... Grand Ballroom

SESSION A

Chairman—Dr. T. P. Hoar, *England*

THE WILLIAM BLUM LECTURE—EDUCATION AND THE ELECTROPLATING INDUSTRY
by Dr. William Blum, *United States*

PROBLEMS ENCOUNTERED IN THE APPLICATION OF PRE-FINISHED METAL
by Dr. S. Wernick, *England*

DEVELOPMENT AND APPLICATION OF ULTRASONIC CLEANING
by J. Zucker, *Switzerland*

EXPERIMENTAL STUDIES OF THE ELECTRODEPOSITION OF METALS IN NARROW CREVICES
by Dr. Henry Leidheiser Jr. and Mrs. Lucille B. Garmon, *United States*

TUESDAY, JUNE 16

9:00 a.m. Educational Session ..... Grand Ballroom

SESSION B

Chairman—G. Ross Davidson, *Canada*

A BLACK CHROMIUM PLATING PROCESS
by Dr. A. Kenneth Graham, *United States*

LEVELING POWER OF COPPER SULFATE BATHS WITH COMPLEXING ADDITION AGENTS
by Dr. Eugenio Bertorelle, Dr. I. R. Bellobono and Dr. A. Scarati, *Italy*

PLATING ZINC ON STEEL FROM PYROPHOSPHATE SOLUTION—A PILOT PLANT INVESTIGATION
by U. F. Marx and D. Povey, *England*

ELECTRODEPOSITION OF NICKEL ALLOYS FROM THE PYROPHOSPHATE BATH
by Dr. T. L. Rama Char, *India*

9:00 a.m. Educational Session ..... Michigan Room

SESSION C

Chairman—Leslie L. Diveley, *United States*

CHEMICAL CONVERSION COATINGS
by Robert F. Ayres, *United States*

THE METAL SURFACE CONVERSION COATING AS A PAINT BASE
by Dr. Robert C. Gibson, *United States*

THE ACCELERATED WEATHERING OF ORGANIC FINISHES
by A. A. B. Harvey, *England*

SURFACE TEXTURE: ITS INFLUENCE ON ORGANIC FINISHING
by Dr. Walter Stein and D. H. Lloyd, *England*

2:30 p.m. Educational Session ..... Artillery Armory

SESSION D

Chairman—William M. Phillips, *United States*

THE INFLUENCE OF THE PHYSICAL METALLURGY AND MECHANICAL PROCESSING OF THE BASIS METAL ON ELECTROPLATING—FERROUS METAL CONDITIONS AFFECTING THE DURABILITY OF WATTS NICKEL DEPOSITS
by Dr. Maurice H. Jones, Chih-Yeu Lu, A. F. Mohenheim and J. Zajdowski, *Canada*

THE MECHANISM OF MECHANICAL POLISHING AS RELATED TO THE NATURE OF POLISHED SURFACES
by L. E. Samuels, *Australia*

OUTDOOR CORROSION RESULTS WITH CHROMIUM-NICKEL-CHROMIUM PLATE
by Dr. Henry Brown and Max Weinberg, *United States*

IMPROVED CORROSION RESISTANCE FOR ELECTROPLATED ZINC DIE CASTINGS
by Dr. Charles L. Faust, Hugh R. Miller and William H. Safranek, *United States*

WEDNESDAY, JUNE, 17

9:00 a.m. Educational Session ..... Grand Ballroom

SESSION E

Chairman—Clarence H. Sample, *United States*

CORROSION TESTING OF ELECTRODEPOSITED COATINGS
by F. L. LaQue, *United States*

EXPERIENCE WITH THE USE OF THE CORRODKOTE TEST
by Donald M. Bigge, *United States*

SULFUR DIOXIDE ACCELERATED CORROSION TEST—TESTING CONDITIONS AND EQUIPMENT
by Dr. J. Edwards, *England*

EXPERIENCE WITH THE USE OF THE ACCELERATED ACETIC ACID SALT SPRAY TEST
by Cleveland F. Nixon, *United States*

GET *ALL* THE ANSWERS
TO *YOUR* FINISHING PROBLEMS

at the
FIFTH INDUSTRIAL FINISHING EXPOSITION!

(Held in conjunction with the
GOLDEN JUBILEE CONVENTION
of the
AMERICAN ELECTROPLATERS' SOCIETY)

The finishing experts will all be under one roof next June. In Detroit, at the Detroit Artillery Armory, from June 15 to 19, at the Fifth Industrial Finishing Exposition!

Take your problems to them. Get expert help . . . at the largest display of finishing equipment, materials and processes ever assembled under one roof.

Make a list of your plating problems. Take it to Detroit with you. See the men who man the booths. The experts with professional, up-to-date help for you. They'll be there to demonstrate the right way to solve your problems.

If you want more information on the Fifth Industrial Finishing Exposition *now*, ask the exposition chairman: • • • • • • • • • •

HOWARD J. McALEER
3171 BELLEVUE AVE.
DETROIT 7, MICHIGAN

9:00 a.m. Educational Session ..... Michigan Room

SESSION F

Chairman—Ralph D. Wysong, *United States*

WATER-SOLUBLE COATINGS FOR METAL FINISHING
by Robert A. Boller, *United States*

EPON RESINS IN THE ELECTROPLATING INDUSTRIES
by H. W. Howard, *United States*

VINYL DISPERSIONS: THEIR USE IN METAL FINISHING
by Myron Perez, *United States*

THURSDAY, JUNE 18

9:00 a.m. Educational Session ..... Grand Ballroom

SESSION G

Chairman—Dr. S. Wernick, *England*

THE EFFECT OF FLOW RATE AND CURRENT DENSITY ON THE ELECTROLYTIC REMOVAL RATE OF IRON AND COPPER FROM A WATTS NICKEL SOLUTION
by Dr. Abraham M. Max and M. L. Whitehurst, *United States*

CHROMIUM IN CYANIDE SOLUTIONS AND ITS REMOVAL
by Dr. Erich Laue, *United States*

ELECTROLESS COPPER PLATING
by Dr. Edward B. Saubestre, *United States*

SOME ASPECTS OF THE CORROSION OF DECORATIVE PLATED COATINGS
by Dr. Frederick A. Lowenheim and William H. Rowan, *United States*

2:30 p.m. Educational Session ..... Grand Ballroom

SESSION H

Chairman—Ezra A. Blount, *United States*

EUROPEAN BRIGHT ANODIZING PRACTICE
by A. W. Brace, *England*

HYDRATION OF ANODIC OXIDE FILMS
by M. S. Hunter, P. F. Towner and D. L. Robinson, *United States*

ANODIZING PROCESSES FOR THE PRODUCTION OF VERY THICK ALUMINA FILMS
by R. Segond, P. Lelong and J. Hérenguel, *France*

DEVELOPMENTS IN THE SURFACE TREATMENT OF ALUMINUM—PROCESSES AND MATERIALS
by Dr. Richard Lattey, *Germany*

FRIDAY, JUNE 19

9:00 a.m. Educational Session ..... Michigan Room

SESSION I

Chairman—A. W. Wallbank, *England*

ELECTROCHEMICAL TECHNIQUE IN MODERN METALLOGRAPHY
by Dr. Pierre A. Jacquet, *France*

THE PRESENT STATE OF ELECTROLYTIC POLISHING IN EUROPE
by Robert Mondon, *France*

THE EFFECT OF SHOT-PEENING AND OF GRINDING ON THE FATIGUE STRENGTH OF CHROMIUM PLATED HIGH STRENGTH STEEL
by R. A. F. Hammond and C. Williams, *England*

SOME CHEMICAL POLISHING PROCESSES—THEIR MECHANISM AND THEIR APPLICATION
by Dr. H. Spahn, *Germany*

INFLUENCE OF VARIOUS SURFACE TREATMENTS ON THE RESISTANCE TO FATIGUE AT HIGH TEMPERATURE OF TWO ALUMINUM ALLOYS
by Gaetan Abadie and Georges Vidal, *France*

9:00 a.m. Educational Session ..... Grand Ballroom

SESSION J

Chairman—A. A. B. Harvey, *England*

THE EFFECT OF STEEL PRETREATMENTS ON THE PERFORMANCE OF WATER THINNED COATINGS
by R. A. Williams, *United States*

VINYLS IN MODERN INDUSTRIAL COATINGS
by W. H. McKnight, *United States*

PROTECTING SILVER AND COPPER AGAINST TARNISHING BY MEANS OF A CHROMATE PASSIVATING PROCESS
by Dr. P. Baeyens and J. L. Melse, *Holland*

CHROMIC ACID ANODIZING CHARACTERISTICS OF WROUGHT ALUMINUM ALLOYS
by George E. Best, J. G. Hecker Jr., John W. McGrew and R. V. VandenBerg, *United States*

2:30 p.m. Educational Session ..... Artillery Armory

SESSION K

Chairman—Dr. Abner Brenner, *United States*

BARREL PLATING WITH SPECIAL CONSIDERATION TO PROTECTION OF THREAD DIAMETERS
by A. W. Wallbank, *England*

DUCTILITY IN PLATED COATINGS
by Dr. Harold J. Read and Thomas J. Whalen, *United States*

GRAIN SIZE CONTROL IN ELECTROFORMING
by H. Denis Hughes, *England*

ELECTRODEPOSITS AS RESISTS IN SELECTIVE HEAT TREATING
by R. Scott Modjeska and Simon P. Gary, *United States*

INTERSOCIETY NEWS

SPE OFFICERS ELECTED; REGIONAL CONFERENCES ANNOUNCED

At its January 26 meeting of the National Council, the Society of Plastics Engineers, Inc. elected its new national officers for the current year. These officers are Fred C. Sutre Jr., Spencer Chemical Co., national president; George W. Martin, Holyoke Plastics Corp., first vice president; Jules W. Lindau III, Southern Plastics, Inc., second vice president; Frank W. Reynolds, IBM Corporation, secretary; Haiman S. Nathan, Atlas Plastics, Inc., treasurer.

SPE has announced a complete schedule of Regional Technical Conferences (RETECS) for 1959 and also a schedule of Annual Technical Conferences through 1964.

Among the RETECS will be Plastics in the Metal Industry, May 7, 1959, at the Penn-Sheraton Hotel, Pittsburgh, Pa. Information may be obtained from John Parks, Hydraulic Press Mfg. Co., 512 Empire Bldg., Pittsburgh 22, Pa.

Also scheduled is a conference on Vinyl Plastics to be held in Cleveland, Ohio on October 7. William Messina, 414 Shawnee Place, Huron, Ohio can supply further information.

GIESEL ELECTED NAMF 2ND VICE PRESIDENT

Robert L. Giesel, president of Adolph Plating, Inc., Chicago, was elected second vice president of the National Association of Metal Finishers in a letter-ballot by fellow directors of the international management group of the job plating industry.

The 41-year-old former chairman of the Chicago Electro-Platers' Institute, the Windy City affiliate of the NAMF, at one time served as a director of the NAMF.

A native of Belleville, Wisconsin, Mr. Giesel is a member of the Executive Club of Chicago, Young Presidents' Organization, Rotary Club and is a 32nd degree Mason and Shriner.

INTERNATIONAL ELECTROCHEMICAL SESSIONS

The Electrochemical Society will hold their 115th National Meeting at the Sheraton Hotel in Philadelphia, Pa., on May 3–7, 1959. Technical sessions will be conducted by the theoretical, industrial electrolytic, electrothermic and metallurgy, electronics and electric insulation divisions.

Special symposia on liquid dielectrics and on electrode processes will be presented, featuring papers by over twenty-five noted electrochemists from Russia, Spain, Germany, Italy, England and this country.

Other details may be obtained from H. C. Mandell Jr., Pennsalt Chemicals Corp., P. O. Box 4388, Philadelphia.

McFARLAND AWARD WINNER CHOSEN

Dr. Robert D. Stout, professor and head of the department of metallurgy at Lehigh University, has been selected at the Pennsylvania State University for the 1959 David Ford McFarland Award for achievement in metallurgy.

The award, which was established in 1949 by the Penn State chapter of the American Society for Metals as an annual recognition for metallurgy graduates of the University, will be presented at a dinner meeting of the chapter on Saturday, April 25.

Dr. Stout has taken a very active part in committee work in technical societies, particularly the American Society for Metals and the American Welding Society.

MASTERS' ELECTRO-PLATING RETURNS TO PLAZA FOR ANNUAL BANQUET

The grand ballroom of the Hotel Plaza in New York City will again be the scene of one of the plating industry's most enjoyable social events on Saturday, May 16, namely the Forty-First Annual Banquet of the Masters' Electro-Plating Association.

The Hotel Plaza, in its fountain plaza setting at the entrance to Central Park, is ideally suited to Masters' annual affair. Prior to the banquet, a reception and cocktail party will be given at 6:30 p.m. During the evening, the customary award will be made to the "Plating Man-of-the-Year" selected by the association. Entertainment and dancing will climax the evening.

Tickets are $25 per person and can be obtained from A. T. Marinaro, executive secretary of the association, 59 East Fourth Street, New York 3, N. Y.

ASM SOUTHERN METALS CONFERENCE TO EXPLORE METALS TECHNOLOGY

The Southern Metals Conference of the American Society for Metals is scheduled to take place in Atlanta, Georgia, May 4 through 6. The Savannah River Chapter of the ASM will act as host. "Metallurgical Frontiers" will be the theme of the Conference.

The program will feature a discussion of advanced concepts in solid fuel power reactors by Walter H. Zinn, nuclear reactor designer and a review of materials research for outer space ventures by D. W. Gates, missile materials scientist from Redstone Arsenal.

Other highlights of the Conference include an address by Clarence H. Lorig, technical director of Battelle Memorial Institute and national president of ASM.

NAMF SEMINAR SPEAKERS ANNOUNCED

Glenn H. Friedt Jr. and Edward N. Marlette, general convention chairman and educational program moderator respectively, have announced the names of three top speakers for the forthcoming convention of the National Association of Metal Finishers. They are John A. Patton, management consultant, Chicago; Lucas Miel of Commercial Steel Treating Co., Detroit; and Joseph H. Lackey, William H. McCoy Co., Detroit.

The management seminar begins Monday, June 15, at Detroit's Statler-Hilton Hotel, with Mr. Lackey leading off with "Cutting Costs Through A Deferred Compensation Program." On Tuesday, June 16, at 10 a.m., Mr. Patton will speak on "Incentive Programs for the Job Plater," followed by Mr. Miel whose topic is "Profit Sharing for Job Shop Platers." At 2 p.m., the same day, the seminar winds up with an off-the-record panel discussion between Messrs. Patton and Miel on "Profit Sharing vs. Incentive Programs."

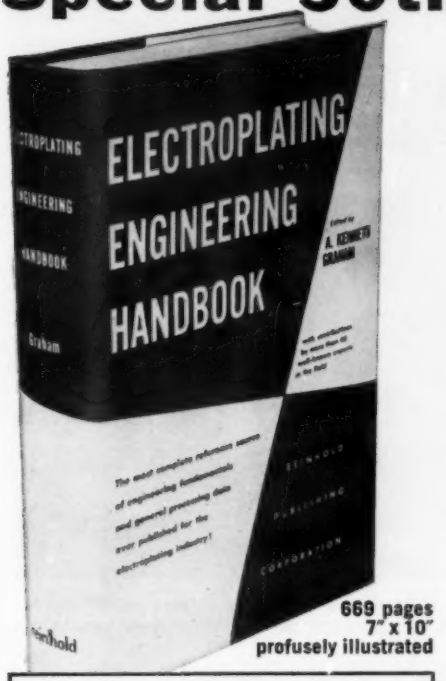
The three-day convention of the job shop owners and operators organization opens on June 14 with an annual membership and board of directors meeting. The traditional reception and banquet Tuesday evening follows a day-and-a-half-long management seminar. A name speaker or entertainer will be a feature of the final banquet, according to Chairman Friedt.

NAMF functions are open to members and non-members.

Special 50th Anniversary Offer

to Members of the American Electroplaters' Society

In connection with its Golden Anniversary, the AES, through a special arrangement with the publisher, is pleased to offer its members an exceptionally low price on an outstanding reference book for electroplaters.



669 pages
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ELECTROPLATING ENGINEERING HANDBOOK

Edited by **A. KENNETH GRAHAM**, President of Graham, Savage & Associates, Inc. in collaboration with over 40 widely-known authorities in the electroplating field.

The complete data book long needed by everyone in the electroplating and metal finishing field. With this big, 669-page book at hand, you can quickly find the answer to practically every imaginable engineering or processing problem!

Jam-packed with tables, charts, plans and illustrations, this Handbook brings you all the most recent information available on processing techniques and the engineering factors involved in constructing and installing plating equipment. Full chapters cover the design of parts to be plated, metal surface preparation, standards and specifications, bath compositions, processing sequences, waste treatment, manual and automatic plating machinery, filtration, rinsing and drying, and all other engineering and operating considerations.

No matter what your interest in the electroplating field—engineer, designer, equipment manufacturer, executive, shop superintendent, purchasing agent, or user of electroplated parts—you'll find just the information you're looking for every time you use this *complete* Handbook.

Check This Wealth of Information

Glossary, **PART I**—GENERAL PROCESSING DATA. Tables of Data. Design for Plating. Metal Surface Preparation and Cleaning: Basis Metal Surface, Polishing, Brushing, and Buffing, Barrel Finishing Methods, Bulk Finishing Small Parts, Finishing Large and Precision Type Parts, Electropolishing, Metal Cleaning, Oxide Removal. Typical Processing and Operating Sequences. Water Requirements for Plating. Plating Bath Compositions and Operating Conditions. Plating Standards and Specifications. Trouble Shooting. Analysis of Plating Baths. Testing Electrodeposited Coatings. Waste Disposal. Plating and Metal Finishing Costs. Industrial Hygiene and Safety. Metallurgy for the Electroplater. Surface Protection and Finishing Treatments: Phosphate Coating Processes, Chromate Conversion Coatings, Chromic Acid Anodizing of Aluminum, Sulfuric Acid Anodizing and Oxide Treatments for Aluminum and Magnesium. **PART II**—ENGINEERING FUNDAMENTALS AND PRACTICE. Plant Location and Layout. Floors—Plans and Construction. Tanks. Linings. Heating and Cooling Practices and Equipment. Racks: Design, Construction, Insulation and Maintenance. Manually Operated Installations. Barrels. Semi- and Fully-Automatic Plating Machines. Continuous Plating Equipment for Steel Mill Products. Anode and Cathode Rod and Bus Systems. Exhaust Systems. Anodes and Cathodes—Types, Composition and Related Data. Low-Voltage D-C Generators. Rectifiers. Periodic Reverse Current Plating. Rinsing. Drying Practices and Equipment. Filtration. Auxiliary Equipment for the Plating Room. Maintenance. Index.

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1 copy $6.00
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INDUSTRY NEWS

(LEFT) Stage of the Rhode Island School of Design Auditorium before the start of the Gold Plating Technology Seminar, sponsored by Sel-Rex Corp. (RIGHT) E. C. Rinker, vice president and technical director of Sel-Rex Corp., pointing to results obtained by new method.

SEL-REX HOLDS GOLD PLATING SEMINAR

Over 300 manufacturing jewelry executives and technical personnel attended the seminar at the Rhode Island School of Design Auditorium on Jan. 29, to watch alloy gold deposited on their own products, by a new method which is said to afford jeweler's finish in any thickness, with a wide range of color shades. The occasion was a private showing and seminar-discussion sponsored by Precious Metals Division, Sel-Rex Corp., to introduce their Karatclad gold process to the manufacturing jewelry industry.

Sample plating was done on products submitted by those in attendance, in a Jet plater. Pen caps, watch cases, chains and assorted costume jewelry were plated in thicknesses ranging from 7-millionths to over 100-millionths, with a jeweler's finish, right from the bath.

Following the continuous demonstrations which were conducted from 2 to 5:30 p.m., a cocktail party was held at thenear by Sheraton-Biltmore, Providence.

The affair resumed in the school auditorium with a seminar-discussion at 8 p.m. The principal speakers were E. C. Rinker, vice president and technical director, Dr. Karl Schumpelt, chief electrochemist, and Rene Rochat, vice president and manager of Sel-Rex's new division in Geneva, Switzerland. The speakers told the audience that the method also offers advantages to users of thinner gold coatings since colors could be produced without variations.

Mr. Rinker noted that the new method offered the manufacturing jeweler new freedom of design, since a substantial layer of gold is applied as the last step in the manufacturing process.

M. E. BAKER TO REPRESENT NARDA

The M. E. Baker Co. announced their appointment as exclusive factory distributors and representatives in Massachusetts, Maine, New Hampshire and Vermont for Narda SonBlaster ultrasonic cleaners.

The company, distributors and manufacturers of electroplating and polishing equipment and supplies, plans to stock a variety of models for immediate delivery to electronic, automotive, and instrument manufacturers, among others.

PFIZER BUILDING PLANNED

The major part of a 32-story office building to be constructed at 235 East Forty-second Street has been leased by Chas. Pfizer & Co., Inc. The structure, to be known as The Pfizer Building, will serve as the world headquarters for the 110-year-old chemical and pharmaceutical firm and its subsidiary companies.

The building will have its main entrance on a 225-foot frontage on Forty-second Street and extend one block north with a 125 foot frontage on Forty-third Street.

The new structure will contain 525,000 square feet of floor space, the major portion of which will be designed to Pfizer specifications.

POWER SPECIALTY REPRESENTS INDIANA COMMERCIAL FILTERS

Power Specialty Co. now represents Indiana Commercial Filters Corp. The CFC product line includes Honan-Crane and Michiana filters. The Houston headquarters of Power Specialty is at 2000 Kipling Street. Dallas office under the direction of George Whittet, is at 4512 Central Expressway.

CENTENNIAL FOR M & H ZINC CO.

One hundred years ago, two enterprising young men selected La Salle, Illinois, as the location for extracting zinc metal from its ores, to provide a metal that the United States needed and did not have. These men were Frederick William Matthiessen and Edward Carl Hegeler.

In December, the company they founded in 1858, Matthiessen & Hegeler Zinc Co., celebrated its centennial.

The story of "M & H," as the company is known in the industry, actually began with the meeting of Matthiessen and Hegeler at the School of Mines in Freiberg, Saxony. This acquaintance grew into a lasting friendship and a life-long partnership.

Today, M & H subsidiaries—Meadowbrook Corp., Spelter, West Virginia, New Castle Chemical Co., New Castle, Pennsylvania, and Barnes Metal Products Co., Chicago, Illinois—combined with the La Salle plant, produce a variety of zinc products and by-products, including slab zinc, plating anodes, alloys, rolled products, zinc dust sulfuric acid and ammonium sulfate.

Entrance to Davies own Texas building

NEW DALLAS OFFICE FOR DAVIES SUPPLY

Davies Supply & Manufacturing Co. has moved its branch office to its own quarters at 2547 Farrington St., Dallas to better handle its Texas business.

The branch will occupy 4,000 sq ft of warehouse space, plus the necessary office facilities, in the new location. Conveniently located for rail and truck traffic, the new building is claimed to be the largest Texas warehouse devoted exclusively to electroplating and related industries.

R. H. Heppel continues as district manager for Davies, which opened its Dallas office in 1949.

TECHLINE OPENS NEW CHEMISTRY LABORATORY

Techline Division of Wheelabrator Corp. has opened a new chemical laboratory in conjunction with the processing laboratory at the Vicksburg plant, with facilities for research and development in the field of barrel finishing compounds.

Mason Atkins has been named chief chemist at the Techline facilities. Atkins formerly served for five years as a field engineer specializing in wet blast precision finishing for Wheelabrator Corporation. Prior to this he was a research chemist for a leading pharmaceutical manufacturer, and quality control chemist for Bendix Aviation Corp.

DETREX APPOINTS TECT NATIONAL DISTRIBUTOR

Tect, Inc. recently announced its appointment by the Detrex Chemical Industries, Inc. of Detroit, Michigan as national distributor for Detrex's trichlorethylene, perchlorethylene and solvent vapor degreasing equipment.

Detrex solvents and equipment will be offered from approximately 38 different points in the United States through Tect, Inc.'s jobbers, warehouses, and direct company sales. These materials will supplement the Tect line of safety solvents, detergents, metal treating compounds and small solvent vapor degreasers.

No matter what the job...

There's a Luster-on® Chromate Conversion Coating to fill your Specifications

FOR BRILLIANT, CORROSION-RESISTANT FINISHES . . . rivaling chrome for many applications where cost is a factor . . . long-lasting, easily controlled applications.

FOR CLEAR AND IRIDESCENT COATINGS . . . most attractive appearance where corrosion-protection, humidity, handling are involved during processing . . . at extremely low cost.

FOR DECORATIVE COLOR . . . on economical zinc . . . scintillating golds, yellows, blues, greens, violets, reds, brass and copper hues.

FOR ALUMINUM . . . where the surface hardness of anodizing is not required.

FOR LASTING BRIGHTNESS . . . on copper and brass without noxious fuming.

FOR DIE CASTINGS . . . uniform, low cost finish ideal for later painting.

LUSTER-ON means economy! LUSTER-ON proved formulas mean excellent operating control!

Data Sheets and Prices on Request

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Los Angeles & San Francisco

Canadian Licensee:
Alloycraft, Ltd.
Montreal

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 431.

WYANDOTTE BUYS ATLANTA PLANT

Robert B. Semple, president of Wyandotte Chemicals Corp., has announced completion of negotiations for the purchase of the Atlanta plant of Tesco Chemicals, Inc.

Plans are to continue the manufacture of the principal Tes-Ted products for both customers and distributors.

Wyandotte will manufacture a complete line of its J. B. Ford Division products at the newly acquired Atlanta plant. These will include metal cleaners and related products. This line of products, however, will not be available from the Atlanta plant for several months—until expansion of the manufacturing facilities is completed.

McALEER LTD. TO DISTRIBUTE WEST GERMAN ABRASIVES

The McAleer Mfg. Co. Ltd. announces that it has been appointed the sole distributor in Canada of the Hermes brand of coated abrasives manufactured by Norddeutsche Schleifmittel-Industrie, Christiansen & Co. of Hamburg-Lurup, West Germany.

MANUAL AVAILABLE TO BRANCHES

As a reference source to help Branches and Branch officers in effective Branch operation, many dedicated National and Branch leaders collaborated, without any remuneration, in preparing the comprehensive BRANCH OFFICERS MANUAL of the American Electroplaters' Society, embodying practically every conceivable Branch operating subject from membership promotion to Delegates' duties.

Within red covers bound by Chicago screws, this 225-page consolidated mimeographed looseleaf book is now in use in 36 AES Branches that ordered copies.

A limited extra quantity of the book is still available at National Headquarters for the accommodation of Branches that have not previously ordered copies. These will be sold to Branches (only), on a first-come, first-served basis so long as that supply lasts, at $5.50 per copy, including postage to one destination.

Write American Electroplaters' Society, Inc., American Building, 445 Broad Street, Newark 2, N. J. Payment should accompany order to obviate unnecessary bookkeeping expense.

PREVIEW OF FUTURE PLATING MAGAZINE ISSUES

MAY 1959

PRE-GOLDEN JUBILEE CONVENTION. A larger than usual issue featuring both technical and scientific papers, together with important coverage of Golden Jubilee Convention, Exposition and International Conference news and data of broad readership importance.

JUNE 1959

GOLDEN JUBILEE. A unique feature issue climaxing the Fiftieth Anniversary observance of the American Electroplaters' Society, PLATING's parent, it will be targeted both for immediate interest to PLATING's global circulation and for long retainment as an AES reference source and as a memento of this year-long observance.

JULY 1959

POST-CONVENTION. An abundant issue carrying not only scientific, technical and practical plating papers and other educational data of substantial readership interest but also much exclusive post-GOLDEN JUBILEE Convention news and features.

AUGUST 1959

Another annual edition of PLATING's widely anticipated WATER AND WASTE TREATMENT issue.

SEPTEMBER 1959

An issue featuring a number of important electroplating and metal finishing articles, plus many features of wide PLATING MAGAZINE readership interest, including an up-to-date copy of the AES's amended Constitution and By-laws, and a financial report covering the fifteen-month period from April 1, 1958 through June 30, 1959.

OCTOBER 1959

Several significant technical and scientific papers will be released in this strong autumn issue, plus many of PLATING's widely anticipated regular features.

NOVEMBER 1959

Third annual edition of PLATING MAGAZINE's popular AIRCRAFT ISSUE, this edition, judging by its blueprint at this stage, looms as one of PLATING's strongest future editions, a worthy follower of expectedly effective SEPTEMBER and OCTOBER 1959 general issues.

DECEMBER 1959

PLATING's always popular Christmas Issue this year implemented by several important innovations.

JANUARY 1960

Another annual edition of PLATING's vaunted "Abrasives and Mechanical Finishing" Issue.

INDUSTRY NEWS BRIEFS

ASTM TO DOUBLE NICKEL THICKNESS SPECIFICATIONS

ASTM Committee B-8 on Electrodeposited Metallic Coatings at its meetings held in Pittsburgh on February 3, 1959, acted to *double* the specified nickel plate thickness in the Specification for Electrodeposited Coatings of Nickel and Chromium on Zinc and Zinc Base Alloys (B 142). This proposed change will become official at the Annual Meeting of the Society in June. The new coating designed to improve the durability and performance of plated zinc die castings is designated Type DZ, and will have the following minimum thickness requirements: copper plus nickel, 0.002 in.; copper, 0.0002 in.; final nickel, 0.001 in.; and chromium, if required, 0.00001 in.

The increased interest in chemically deposited nickel for wide variety of uses has encouraged ASTM Committee B-8 to publish a symposium on Electroless Nickel Plating. The symposium will be published in the Fall of 1959. Eight papers and a bibliography will bring together all known information on Electroless Nickel. Many photographs and tabular data will be included.

PLAN ELECTROCHEMICAL BASIC RESEARCH AT METAL & THERMIT

Plans for expansion of electrochemical research and development activities have been announced by Dr. C. Kenneth Banks, vice president, research, Metal & Thermit Corp.

Dr. Banks announced the purchase of previously leased facilities in suburban Detroit for the company's electrochemical research laboratory and pilot plant. "Future plans for this facility," he said, "call for acceleration of existing research programs in chromium, copper, nickel, and tin plating, as well as investigations into the plating of other metals. Also, and importantly," he continued, "we will add basic research in electrochemistry—the electro-winning and electro-refining of metals, and the electro-production of chemicals."

DETREX TO EXPAND KENTUCKY PLANT

Detrex Chemical Industries, Inc., 14331 Woodrow Wilson Avenue, Detroit, Michigan, has announced a one-quarter-million-dollar expansion program at their Bowling Green, Kentucky plant.

This will provide approximately twenty-five per cent additional production space.

BRITISH TRANSLATE RUSSIAN TECHNICAL MONTHLY

An English translation of one of Russia's leading technical journals is now being published monthly in Britain. Britain's Production Engineering Research Association (PERA), which is supported by the British Department of Scientific and Industrial Research, is making cover-to-cover translations of "Stanki i Instrument," under the title of "Machines and Tooling."

PERA has undertaken this task to enable engineers to study for themselves the developments taking place within Russia in production techniques and equipment.

ANNUAL ZINC INDUSTRY REVIEW

"A Review of the Zinc Industry in the United States During 1958," a new 16-page booklet, has just been published by the American Zinc Institute, Inc., 60 East 42nd Street, New York 17, N. Y.

The Review summarizes the production and consumption picture of the zinc industry as of December 31, 1958. Detailed tables give comprehensive data.

Effects of the recession on the zinc industry and its major markets are described in some detail, with emphasis on the die casting and galvanizing industries. A new world-wide zinc and lead industry research program initiated in 1958 is reported. Copies may be obtained without charge.

Barrel Nickel Plating

●

Most of us own automobiles. Probably all of us have had some very trying experiences with them. Running out of gas is among the least of these. Always we want to blame the gas gauge rather than our own judgment. We look at the tires and decide they'll go another thousand miles (we hope).

●

Actually most of the time we are expecting a certain performance. Maybe we ran out of gas because the motor needed tuning up and the mileage was poor. The wheels were out of line and the tires didn't last as long as they should.

●

Your barrel nickel plating operation needs just as much attention. If the solution is dirty and run down can you expect good performance? Maybe the barrel has danglers that are built up and shortened and you expect the same contact you originally had.

●

The barrel you are using may have tiny holes you bought for one job and now you're complaining because it doesn't draw the current you'd expect from a new barrel with larger holes. It's very easy to promise results but is your equipment capable of providing these results?

●

Solutions sound easy to maintain but we find many solutions well below normal operations. Some work will drag out as much as 25% of the solution in a week, so close checking is advisable until dragout losses are established. The formulas True Brite pioneered about fifteen years ago are now standard. Our bulletin gives the details.

●

True Brite offers you a choice of addition agents which can be used with many formulas over wide ranges of conditions. You can have a barrel nickel plating system which is individually tailored to fit your requirements. Avoid disappointment and really try True Brite Nickel Brightener. We have our regular bulletin and offer individualized attention to your inquiry that no large company can offer. Don't hesitate to let us try to help with your problems.

TRUE BRITE CHEMICAL PRODUCTS CO.
98 FALLS AVENUE OAKVILLE, CONN.

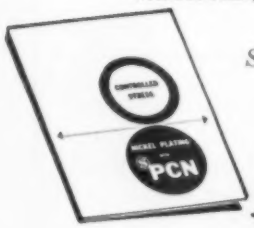
Looking for "hugging power" in Nickel Plating Baths?

SEYMOUR PCN®
Stress Reducing Agent
is YOUR ANSWER!

The average Watts solution . . . without any stress relieving agent . . . will deposit nickel having a tensile stress of 23,000 psi and a hardness of 150 VHN. The addition of Seymour PCN in proper amounts will convert this tensile stress to a compressive stress thus depositing a nickel which tends to hug the base metal. Further, the degree of compressive stress can be controlled through a range from zero to 8,000 psi! The hardness of the nickel deposit increases from 150 VHN to 600 VHN without any loss in the high ductility characteristic to all Seymour plating solutions.

Other PCN Characteristics:

- Nickel deposits of high chemical purity.
- Excellent grain structure and high ductility.
- Excellent corrosion resistance.
- Easy removal of PCN from bath, through carbon purification.
- No breakdown or formation of organic contamination.
- Operation in pH range of 2.0 to 5.0 without change of color in the deposit.



Send for your copy of this Technical Brochure on Seymour PCN

ELECTRO CHEMICAL SUPPLIES DIVISION
THE SEYMOUR MANUFACTURING Co.
5 FRANKLIN STREET • SEYMOUR, CONN.

PATENT ABSTRACTS

DR. D. GARDNER FOULKE
Manager, Electrochemical Development
Hanson-Van Winkle-Munning Co
Matawan, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,856,322, 10/14/58—Phosphate Coating—R. Parson and J. Truhler assignors to Pullman-Standard Car Mfg. Corp., Chicago, Ill.

A solution for laying down an iron phosphate film is described as consisting of an acid pyrophosphate providing 0.5 to 5 per cent of pyrophosphate ions. The *ph* is given as 1 to 7 and the temperature as 130 to 200F.

4 claims.

No. 2,856,333, 10/14/58—Electroplating on Al, Zn, Ti and Pb—O. Topelian—assignor to Tiarco Corp., Newark, N. J.

Claim 1 reads:

A process of electroplating an article formed of a metal selected from the group consisting of aluminum, titanium, zinc and lead comprising subjecting the article having a temperature substantially equal to room temperature to the action of hydrogen chloride gas removing the article from the hydrogen chloride gas medium when the article appears to sweat and electroplating the article.

No. 2,856,334, 10/14/58—Chromium Plating—P Topelian—assignor to Tiarco Corp , Newark, N. J.

Plate a chromium covered article by submitting first to a gaseous hydrogen halide atmosphere until green in color, then plate with chromium.

18 claims.

No. 2,856,344, 10/14/58—Anode Rack—S. Lapham—assignor to Hard Chrome Plating Corp., Emeryville, Calif.

A rack for plating cylinders is claimed.

5 claims, figure.

No. 2,856,345, 10/14/58—Article Holder—J Pociask, assignor to American Spring & Wire Specialty Co , Chicago, Ill.

A holder for ball bearings and the like similar to a ball anode container is described.

4 claims, 3 figures.

No. 2,856,682, 10/21/58—Silver Lined Steel Structure—J. Chyle—assignor to A. O. Smith Corp., Milwaukee, Wis.

Clad the carbon steel with stainless steel containing less than 25 per cent nickel and arc weld the silver thereto.

4 claims, figure.

No. 2,857,292, 10/21/58—Protective Coating—D. Moore, assignor to USA (Air Force).

Prepare a slip of chromium, boron and nickel in eutectic proportions and a frit of quartz, feldspar and borax; place slips on metal and fire at 1850 to 2100F.

7 claims, figure.

No. 2,857,295, 10/21/58—Method for Improving Electric Storage Batteries—H. Brown, assignor to the Udylite Research Corp., Detroit, Mich.

Add 0.0005 g/l to saturation of a perfluoroalkane of 5 to 10 carbon atoms to the electrolyte.

13 claims.

No. 2,857,297, 10/21/58—Coating Molybdenum—J. Moore, et al, assignor to National Research Corp., Cambridge, Mass.

Apply an "Al-Si" alloy coating, oxidize slightly, then heat to 2000F in absence of air to form a molybdenum silicide interface between the Mo and the Al-Si.

7 claims.

No. 2,857,298, 10/21/58—Cleaning and Phosphating Metal—C. Smith, Wayne County, Mich.

The cleaning, phosphating solution is described as 50–80 per cent of an acidic phosphating solution, 4–30 per cent of a hydrocarbon solvent, 10–20 per cent of an emulsifier and an alkali metal alkyl benzene sulfonate detergent.

20 claims, figure.

No. 2,857,300, 10/21/58—Coating and Hardening Steel—H. Moller, assignor to American Mollerizing Corp., Beverly Hills, Calif.

To treat high carbon spring steel to yield a martensite structure and coat, pass stock into a molten chemical flux bath (above critical temperature of steel) thence into molten aluminum in a clean condition then quenching immediately

6 claims.

No. 2,857,321, 10/21/58—Soldering Aluminum—J Williams, assignor to Raytheon Mfg Co , Waltham, Mass.

Aluminum or other metals having a tenacious oxide film can be soldered by immersing the oxide covered object and that to be connected thereto in a heated electrolyte and causing a current to flow through said electrolyte while bringing the solder in contact with the object and material to be soldered thereto.

9 claims, figure.

No. 2,857,664, 10/28/58—Coated Refractory Body—D. Luks & J. Powell, assignors to Frenchtown Porcelain Co., Trenton, N. J.

Coat refractory body with a metallic base glass consisting of 5 to 30 per cent of Mo or W, 40 to 85 per cent Ni, Co, Fe and powdered manganese, not exceeding 35 per cent and 5 to 30 per cent powdered glass. Fire at 1500 to 2300F in a reducing atmosphere, then solder a metallic body thereto.

15 claims, figure.

No. 2,857,697, 10/28/58—Etching Machine—N. Schutt, et al assignors to Powers Chamco, Inc., Glen Cove, N. Y.

An etching machine where the etching acid is continuously applied is described.

17 claims, figure.

No. 2,858,245, 10/28/58—Enameling Aluminum—J. Carrol and J. Thirsh, assignors to Amchem Products, Ambler, Pa.

Claim 1 reads: "The method of applying vitreous enamel coatings to aluminum and aluminum alloys which comprises subjecting the metal surface to be enameled to a sequential series of operations to clean and pretreat said surfaces before applying and firing the enamel coating, said sequential operations comprising first subjecting said surface to the action of an aqueous alkali solution, thereafter subjecting said surface to the action of a deoxidizing solution capable of dissolving metallic oxides, and then forming a chromate conversion coating on said surface by subjecting it to the action of an aqueous acidic solution containing hexavalent chromium ions and fluoride ions, rinsing the surface to remove the treating solution, and thereafter applying the enamel to the thus treated surface and forming the vitreous enamel coating by fusing the enamel.

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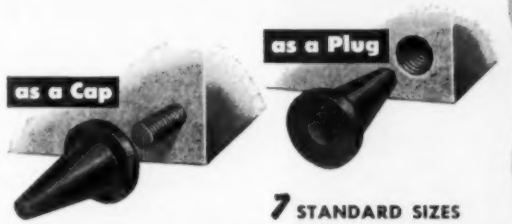

7 STANDARD SIZES

	A	B	C	D	E	F	G
TO PLUG HOLE SIZE	1/8-3/16	3/16-1/4	1/4-5/16	5/16-1/2	1/2-5/8	9/16-11/16	5/8-3/4
TO CAP STUD SIZE	3/32-5/32	5/32-3/16	3/16-1/4	1/4-5/16	5/16-3/8	3/8-7/16	5/16-1/2

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DUGGAN Masking Devices

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No. 2,858,256, 10/28/58—Electrophoretic Method—F. Fahnoe and J. Shyne, assignors to Vitro Corp. of America, New York, N. Y.

A precision dimensioned abrasive article can be made from a master by plating thereon by the electrophoretic method the abrasive particles, then bend the deposited particles and strip from the master.

19 claims, figure.

No. 2,858,257, 10/28/58—Purification of Electrolytes—M. Ceresa, assignor to Westinghouse Electric Company, E. Pittsburgh, Pa.

A process for purifying Au, Ag, Cu, Zn, Cd and brass cyanide solutions is described as including the steps of 1) adding to the electrolyte a mixture of calcium cyanide (25 to 75 per cent), alkali metal cyanide (45 to 10 per cent) and calcium oxide (50 to 5 per cent) in sufficient quantity to react with excess carbonate; 2) agitating to cause the reaction to go to completion; 3) holding quiescent to allow the precipitate to settle out; 4) then filtering.

7 claims.

No. 2,858,265, 10/28/58—Plating Rack—Max Schneider—Chicago, Ill.

A rack is described consisting of a main bus bar and an auxiliary bus bar, detachable clamping means maintaining said main and auiliary bars in a fixed transverse relationship.

See also No. 2,858,266 describing a plating rack, 3 claims, figure.

2 claims, figure.

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Complete Line of Guaranteed, Quality

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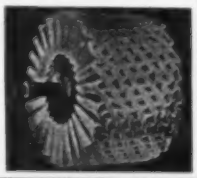

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Starts 9:30 a.m. Morning & Afternoon Sessions
FIVE SPEAKERS

7 p.m.—Banquet at University Club
Registration—$7.50, includes
Luncheon and Banquet
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MODEL CIAC

Interrupts voltage to main line starter of rectifier feeding current to plating tank, where interruption is desired. Capable of handling rectifiers with capacity ranges from 500 to 10,000 amps.

TYPE CIDC

Interrupts current using auxiliary DC switch of proper capacity for interruption at bus-bars. Models available from 250 to 1500 amps DC:

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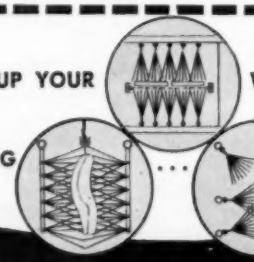

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*Controlled Flow** **SPRAY NOZZLES**

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ADJUSTABLE JOINTS—For fast easy positioning and re-positioning of nozzles relative to work. Complete choice from ¼" to 2½" pipe size connections.

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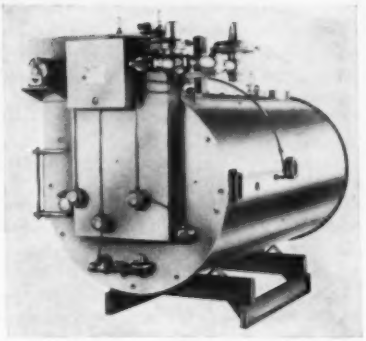
TRADE LITERATURE

L—401. Anodizing Spline—An eight-page catalog has been made available by LeVita Industries, Inc. describing their new titanium anodizing spline. This spline, light in weight, is operated either by hand or automatically. It can be used singly or joined to form racks. Present clips or pure titanium clips can be utilized. Accessories are illustrated in the catalog, as well as pictures of the spline itself.

L—402. Spraying Equipment—A new catalogue covering recently introduced and improved spray equipment has been released by The DeVilbiss Co.

Included in catalogue A-53 is complete information on 15 different models of spray guns, air compressors, air regulating equipment, paint cups and tanks, spray booths, exhaust fans, hose and connections, infra-red drying equipment, hot spray units, respirators and underbody coating equipment.

L—403. Conversion Coating Compounds—A new group of compounds for producing chromate conversion coatings on zinc and cadmium plate, zinc base die-castings and aluminum is fully described in Technical Data Sheet No. 76, a five-page usage and instruction sheet prepared by MacDermid Incorporated. Called Macromates, these new products are available in colors from clear to olive drab. Most are dry powders that are easy and safe to use. Macromates are claimed to reduce brightener cost, add corrosion resistance, improve product appearance and provide base for paint or organic coatings.



L—404. Blast Immersion Water Heaters—New Sellers Model BT blast immersion water heater is illustrated and described in a four-page No. 5220 brochure. Catalog listings include size of wide range of available shells, storage capacity, hourly BTU input and hourly recovery capacity. Details are shown of the Model BT arrangement of blower, burner assembly and accessories.

L—405. Selenium Photocell Catalog—An 8-page catalog PC-649A entitled "Selenium Photovoltaic Cells," published by International Rectifier Corp., describes a complete line of self-generating photocells. Over 25 standard selenium cell types are described.

L—406. Safety Chart—Ten "Do's" and ten "Don'ts" of grinding wheel safety are listed brightly on a red, white and black 12 by 12 in. wall chart made available by The Carborundum Co.

Terse copy, easy to read, easy to remember, the chart is designed for hanging in a handy spot.

L—407. Metal Finishing Chemicals—Allied Research Products, Inc., has announced the issuance of a new technical data file on process chemicals for metal finishing. It includes data on the Iridite chromate conversion coatings for non-ferrous metals, Irilac clear protective coatings for all metals, Isobrite plating brighteners and ARP process chemicals and supplies.

The new data brings together, within one volume, complete information on all process chemicals added to the Allied line since the acquisition of Wagner Brothers, Inc. last June.

L—408. Silicone—The 1959 Reference Guide to Dow Corning silicone products describes what silicones can best meet the needs of a variety of problems. It gives information on how to get specific data on the silicone material best suited to any application.

This 16-page, up-to-date reference guide is heavily illustrated and features an expanded indexing system.

L—409. Barrel Finishing Equipment—Fourteen standard units, 2 small barrel models and 11 specialized barrel finishing machines are described in a new 4-page, illustrated brochure B-25-C just published by Almco, Queen Products Division, King-Seeley Corp. The firm's complete line of barrel finishing compounds and media is also described.

ANODIZING BASKET

Lucite Basket—8" ID, 9" OD, 13" high

Replaceable inside parts
¾" dia. aluminum rod
Heavy cast aluminum top and bottom for long life

Will anodize approximately 10 lbs. of aluminum
Inexpensive

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EQUIPMENT AND SUPPLIES

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E—401. Non-Acid Stripper—Striplite, a single dry salt is a new, non-acid material for removing rust, scale and black oxide from steel. It will not attack the base metal, according to Du-Lite Chemical Corp., the manufacturer.

The salt is dissolved in water at a ratio of from 1 to 4 lb/gal and the solution is used at 180F to boiling. If necessary, it can also be used electrolytically. Activity of the solution is proportional to its strength, temperature, and the presence or absence of electric current.

The salt is said to work successfully in extreme cases, including removal of heavy black oxide.

E—402. Silicon Rectifiers—1500 PIV, 300 ma rated silicon rectifiers that are said to exhibit more stable characteristics at high temperatures than ever before obtainable are now available from International Rectifier Corp. These stable units offer reverse leakages as low as 100 ua at 75C (at rated PIV of —1500 v dc). Maximum forward voltage drop at a test temperature of 25C at 150 ma is 4.5 v.

Designed primarily for high temperature operation, these units are stud mounted for optimum heat dissipation, and may be operated at temperatures up to 150C. Their high inverse voltage (1500 v minimum) combined with the ability to withstand severe shock and vibration makes them especially suitable for missile and airborne equipment applications.

E—403. Bond Finish—Kirsch Co. is now offering a new Kirco-Bond finish which retards flaking and peeling of paint, according to the company.

A zinc phosphate coating, it is applied over a very thin deposit of electro zinc. It prevents reaction between the zinc surface and the paint finish, thereby increasing the durability and quality of the paint product.

The finish gives protection to raw material in storage and to unpainted areas of finished products.

It can also be used as an aid in drawing in certain types of metal fabrication. The phosphate coating retains oil under high forming pressures. The phosphate itself takes part in the drawing and prevents scoring and galling.

E—404. Dry Fluoride.—Fluromine, a new product of Platers Research Corp. is a dry fluoride containing compound used in the acid treatment of metals. It is said to be less hazardous to use than liquid hydrofluoric acid.

It can be used in a water solution as a smut remover or in conjuction with nitric acid or sulfuric acid. The powder improves the pickling of colloidal silicate films, sand castings, activating and bright etching of aluminum and magnesium, stainless steel and titanium. It is free flowing.

E—405. Portable Tumble-Finisher—Precision and portability for small parts finishing, deburring and polishing operations are now obtainable with the Model RA Rollabrader, now manufactured by Rampe Mfg. Co. The 0.5 cu. ft. machine

features barrel drive system using four neoprene rollers and dual drive shafts and has a lift-off barrel. Variable speed drive is adjustable from 20 to 46 rpm.

Other features include orange-colored vinyl barrel lining, lifting handles on both barrel and machine bed, and heavy-duty welded construction suitable for steel ball burnishing.

Typical uses include short runs of small production parts, experimental processing, precision finishing of delicate parts and similar small volume work.

E—406. Alkyd Enamel—A new, all-purpose, alkyd enamel for exterior and interior wood and metal application was announced by The Glidden Co.

Called Industrial Speedenamel, it is offered in a wide variety of colors for product finishing and maintenance painting.

The enamel is adaptable for brush, spray or dip application and can be air-dried or baked in conventional baking equipment. The resultant finish provides a tough, flexible film with exceptional resistance characteristics according to the manufacturer.

E—407. Dry Pickler—A new dry mixture that pickles all base metals and also strips chromium was introduced by Hanson-Van Winkle-Munning Co.

Pickelene 300 will produce a bright, smut-free surface and will give off no objectionable fumes it is said.

The mixture includes acid salts, activators, and surface active agents. An aqueous solution may be used as an activating acid dip prior to plating on steel, brass, copper, or zinc die castings, or as a pickle for removal of rust, heat treat scale, oxides, and residues of brazing flux from steel.

Most operations employing Pickelene 300 may be performed in lead, Koroseal, or rubber tanks, but the manufacturer recommends lead if operating temperature is to exceed 180F.

Concentration of solution varies from 4 to 32 oz/gal, depending upon application.

E—408. Stripper—Patclin Chemical Co. Inc., has developed a new zinc chromate paint stripper designated as Patclin No. 206. It has been developed to strip zinc chromate primer and Army and Navy spec. olive drab coatings from aluminum, zinc, magnesium and steel without attacking the base metal or affecting the bonderizing, alodizing or anodizing.

It is used cold, as is, in a mild steel tank. Patclin No. 206 is said to remove zinc chromate primers, alkyds, styrenated alkyds, nitro cellulose, cellulose acetate and oil base coatings. It is effective on die castings and phosphated surfaces where the large surface area gives the coatings a strong adhesive bond and where the lifting type stripper is unable to do a clean job and necessitates hand brushing.

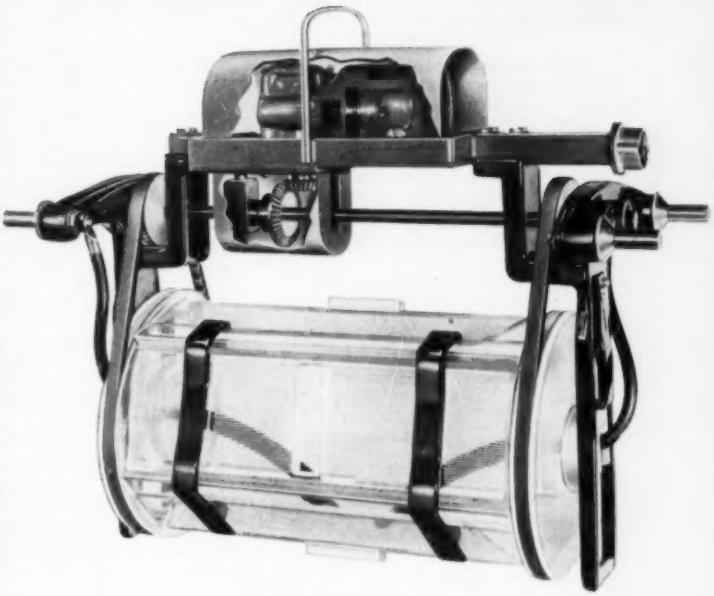
It dissolves the coating without causing it to become sticky and solublizes it so that the stripped piece can be rinsed clean, with water, without leaving residues and without necessitating hand scrubbing.

E—409. Caustic Soda Booster—Savings in cost and space requirements are now claimed possible with a new activator called Lonco Alka-Strip Booster by the London Chemical Co. Using a ratio of 1 pt to 500 gal of caustic solution, it replaces wetting, dispersing, settling and softening agents.

With Alka-Strip Booster, caustic solutions are said to work faster, better and last longer, one pound doing the work of 100 times as much alkali additives. Sludge is agglomerated and suspended instead of going into solution or settling on tank bottom, keeping solutions clean and active for much longer periods of time.

STUTZ
presents a new design in
PLATING BARRELS

Featuring
Motor drive integrally mounted
Complete cycle
Continuous rotation from one operation to the next
Cog belt cylinder drive
Positive grip one piece outboard mounted cog pulleys



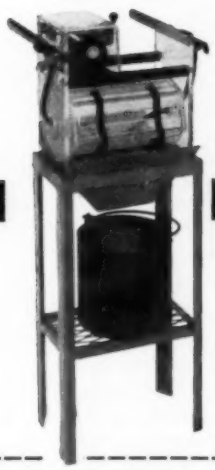
The Stutz Co. has advanced plating barrel design and construction so that today these units are highly productive and maintenance reduced to a minimum. Costly replacement parts such as cylinder gears and bearings are eliminated completely. The only expendable parts are the belts. To provide long belt service, a special non-stretch cog belt with internal steel reinforcement is used. Belts can be changed, if necessary, in seconds at the tank without tools. The Stutz hanger extends below the cylinder thereby adding protection to the cylinder and also permitting the assembly to be lowered to the floor. The Stutz assembly incorporates a lock-in design that permits removal of the cylinder instantly from the hangers without the use of tools. This means cylinders with special perforations or partitions can be installed or removed quickly.

The motor-combined unit shown affords special economy since drives on tanks are not required, and rotation of the cylinder can be continued from one operation to the next. Solution dragout is therefore reduced to a minimum. This design is ideal for application on the carriers of a full automatic conveyorized plating machine.

The motor drive to the countershaft is through bevel gears operating in a gear case and permanently lubricated. Standard R.P.M. of the cylinder is 5; however, other speeds are obtainable at no extra cost. Hanger arms completely covered with fused plastisol.

The initial cost of belt driven units is substantially lower than gear driven barrels, and maintenance virtually eliminated.

"Motor Drive from Side of Tank Always Available."



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The Stutz Portable Barrel is made in 3 standard sizes with cylinders having inside dimensions of 6"x12", 8"x18" and 10"x18" I.D. Smaller upon application. Standard openings are 3/32". Smaller or larger openings can be furnished as required.

- Baskets in perforated metals or wire mesh.
- Load/Unload Stand for convenient and fast handling of work load.

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COMPLETE METAL FINISHING EQUIPMENT AND SUPPLIES

ARTICLE REFERENCES

By
WILLIAM TUCKER
Eastman Kodak
Rochester, N.Y.

Most of the articles listed here may be obtained by writing to the publications in which the articles were published. Addresses are given at the end of the references for the reader's convenience.

Photostat or microfilm copies of articles in available magazines may be obtained from: Library of Congress, Washington, D. C.; New York Public Library, New York; Engineering Societies' Library, New York, at prevailing rates. In other cases, consult Wilson's Union List of Serials at your nearest public library for other sources of these articles.

41. ANALYSIS

a. *SULFATE DETERMINATION IN CHROMIUM PLATING SOLUTIONS—VOLUMETRIC METHOD USING E.D.T.A.*
Saburo Konishi.
Metal Finishing, *57*, No. 2, February 1959, pp. 59–60.

42. CORROSION

a. *CHROMIUM PLATING IN RELATION TO THE CORROSION RESISTANCE OF NICKEL-CHROMIUM DEPOSITS.*
Alan Smart.
Electroplating and Metal Finishing, *12*, No. 1, January 1959, pp. 3–10.

43. ELECTROLESS NICKEL

a. *ELECTROLESS NICKEL PLATING OF CARBON.*
Harry J. West.
Metal Finishing, *57*, No. 2, February 1959, p. 64.

44. ELECTROPLATING

a. *COMPOSITION AND APPLICATION OF ANODES.*
D. J. Fishlock.
Metal Finishing, *57*, No. 2, February 1959, pp. 48–51, 57 (Part I).

b. *MECHANISM OF ELECTRODEPOSITION OF NICKEL FROM LIQUID AMMONIA SOLUTIONS OF SPIN-FREE NICKEL (II) COMPLEXES.*
George W. Watt and David A. Hazlehurst.
Journal of the Electrochemical Society, *106*, No. 2, February 1959, pp. 117–119.

c. *ELECTRODEPOSITION OF MOLYBDENUM.*
T. T. Campbell.
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d. *A MISSILE-MAKER'S TITANIUM PLATING PROCESS.*
C. W. Handova.
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a. *VAN DER HORST EVALUATES TITANIUM TUBING FOR HEATING AND COOLING CHROME SOLUTIONS.*
Products Finishing, February 1959, pp. 59–62.

b. *PROGRESS IN RECTIFIERS.*
K. M. G. Stewart.
Electroplating and Metal Finishing, *12*, No. 1, January 1959, pp. 19–20.

c. *WHICH RECTIFIER FOR ELECTROPLATING—SILICON OR GERMANIUM?*
J. T. Cataldo.
Metal Finishing, *57*, No. 2, February 1959, pp. 69–70.

46. ETCHING

a. *CURRENT PRACTICE IN CHEMICAL MILLING.*
Dr. Neil W. Berst.
Products Finishing, February 1959, pp. 31–35.

47. METAL SPRAYING

a. *SECOND INTERNATIONAL CONFERENCE ON METAL SPRAYING. (PART I).*
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48. MISCELLANEOUS

a. *PLATING PROCESS CO-DEPOSITS OXIDES OR CARBIDES.*
A. E. Grazen.
The Iron Age, *183*, No. 5, January 29, 1959, pp. 94–96.

49. WASTE DISPOSAL

a. *TREATMENT OF EFFLUENTS IN THE METAL FINISHING INDUSTRY (PART I).*
Dr. Richard Justh.
Electroplating and Metal Finishing, *12*, No. 1, January 1959, pp. 11–14.

b. *PLATING WASTE DISPOSAL—INTEGRATED SYSTEM AT RONSON CORPORATION.*
Walter Mikos and Alfons Szkudlapski.
Metal Finishing, *57*, No. 2, February 1959, pp. 61–64.

The following are metallurgical abstracts taken from the Journal of the Institute of Metals.

October 1958 issue, pp. 183, 186, 187, 188.

CHANGES IN THE DIMENSIONS OF ALUMINIUM ALLOY ARTICLES DURING ANODIC OXIDATION.
A. V. Shreider.
(Zhur. Priklad. Khim., 1957, 30, (1), 84–97)—(In Russian).

BRIGHT-COPPER PLATING FROM A CYANIDE BATH IN THE PRESENCE OF POTASSIUM TARTRATE. I. RELATION BETWEEN BATH COMPOSITION, BRIGHTNESS AND LEVELLING.
Teiichi Ito.
(Rep. Gov. Indust. Research Inst. Nagoya, 1957, 6, (8), 422–428)—(In Japanese).

A FLAME SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF NICKEL AND BORON IN PLATING SOLUTIONS.
D. E. Fornwalt
(Anal. Chim. Acta, 1958, 17, (6), 597–603).

ELECTROPLATING AND METAL PRESERVATION STUDIES UTILIZING RADIO-ISOTOPES.
Stanley L. Eisler.
(ASTM Symposium on Radio-Isotopes, 1958, 5–12; discussion, 13).

November 1958, pp. 271, 275, 276.

Influence of the Method of Anodic Passivation and of the Concentration of the Electrolyte on the Porosity of Al_2O_3 Films. A. F. Bogoyavlensky and N. V. Siletskaya (Zhur. Proklad. Khim., 1956, 29, (8), 1295–1297). (In Russian.) Specimens of Al alloy D-16-T (contg. Cu 3.8–4.9, Mg 1.2–1.8, Mn 0.3–0.9 per cent) sheet were anodized by the H_2SO_4, CrO_3 and carbonate methods. The porosity of the anodic film was then determined by the mineral-oil method of Tomashov and Byalobzheskii (Trudy Inst. Fiz. Khim., Akad. Nauk S.S.S.R., 1951, 3, 17), and the thickness of microscopy. In the case of the H_2SO_4 and carbonate methods, the porosity increases considerably with increasing electrolyte concentration, attributed to etching of the film by the bath. With the CrO_3 bath, porosity cannot be directly related to concentration, although there is a tendency to decreased porosity at higher concentrations; evidently the etching effect was suppressed by the oxidizing action of the medium. Under standard working conditions the porosity decreased in the order sulphate → chromate → carbonate. Anomalous values for the porosity of films produced by the oxalic acid method were probably due to corrosion of the metal underneath the film during anodizing.

Influence of the Relative Contents of Sodium Cyanide and Sodium Hydroxide in Zinc Electrolytes on the Mechanical Properties of Steels. I. I. Moroz and N. T. Kudryavtsev (Metallovedenie i Obrabotka Metallov, 1958, (4), 25–28)—(In Russian). Steel specimens were Zn plated in baths with various ZnO, NaCN and NaOH contents. U.T.S., elongation and reduction of area of plated and unplated specimens were measured and are plotted against plating time; there was a continuous deterioration in mech. properties during plating, associated with adsorption of H by the steel. The amount of H increased with increases in cyanide concentration and plating time. The least changes in properties were observed in baths contg. NaCN 1–1.5, NaOH 2.5–3, Zn 1 mole/l.

Zinc Plating in a Cyanide Electrolyte and the Mechanical Properties of the Steels. I. I. Moroz and N. T. Kudryavtsev. (Metallovedenie i Obrabotka Metallov, 1957, (8), 28–33)—(In Russian). H embrittlement of mild and low-alloy steels during plating was studied by a bend test and detn. of mech. properties. Chem. degreasing, electrolytic degreasing or pickling before plating had little or no influence on the mech. properties. Several of the materials tested were not adversely affected by up to 90 min plating, even if first nitrided or carburized. The effects of heat-treatment, before and after plating, and of varying the c.d. are discussed.

Influence of Microrelief on the Current Distribution on Electrodes. L. I. Kadaner (Zhur. Priklad. Khim., 1957, 30, (1), 72–80)—(In Russian). Microrelief (e.g. spongy electrodeposits, sandblasted or filed surfaces) had a significant influence on the current distribution, the effect being greater with higher electrode polarization and elect. conductivity of the bath and with smaller dimensions of the cathode regions of different relief. The effect explains the rapid growth of spongy deposits and supplements Kudryavtsev's suggestions (Doklady Akad. Nauk S.S.S.R., 1950, 72, 93; M.A., 19, 611) concerning the formation of spongy deposits from zincate baths. Sponge and dendrite formation must be prevented on jigs, etc as wel as the work, and articles with different surfaces should not be

simultaneously plated in the same bath. The baths studies included acid Cu, acid Sn, sulphate Ni and zincate.

A Conference on Current Distribution During Electrodeposition of Metals. L. I. Kadaner (Zhur. Fiz. Khim., 1957, 31, (9), 2149–2150)—(In Russian). The conference was held in Moscow in April 1957. V. G. Levich considered the theoretical aspects of current distribution, analysing different factors by themselves and in the presence of others. A. V. Izmailov stressed the necessity of distinguishing between concentrational and chem. polarization. He also dealt with the relationship between throwing power of electrolytes and the energy of activation. N. P. Gnusin reported on models for the electrochem. system derived by an electro-integrator and by an oscillograph. K. considered more practical aspects of current distribution, analysing quant. the relationship between current and metal distribution on different geometrical patterns. A. V. Leontiev spoke of the use of trace elements for current-distribution studies. G. S. Vozdvizhensky and N. V. Kulpina reported on the study of the influence of current distribution on the properties of the deposit. The conference reviewed the book by A. T. Bagramian and T. B. Il'ina-Kakueva. "Current Distribution on the Surface of Electrodes During Electrodeposition of Metals."

December 1958, p. 327.

Surface Hardening of Titanium by Treatment in Fused Borax. A. N. Minkevich and Yu. N. Shul'ga (Metallovedenie i Obrabotka Metallov, 1957, (12), 53–61; also (abridged translation) Metal Ind., 1958, 93, (4), 67–69)—(In Russian). Forged Ti alloys LS (0.5–0.6 per cent C) and LO.5 V (W 0.5 per cent) were cathodically treated (c.d. 0.1 amp./cm.^{2}, 12–15 V) in fused borax. The surface hardness (H_{vs}) was increased from 250–300 to 700–950 and the Amsler wear-resistance was equivalent to that of nitrided or carburized steels. However, this was accompanied by grain growth and a reduction in elongation, strength, and ductility; treatment over-prolonged or at too high a temp. caused excessive brittleness (3 hr. at 900–930C is recommended). The process is principally oxidation, not boronization, and the layer of solid soln. of 0 in Ti had a characteristic acicular structure. Treatment of LO.5 V alloy at 1050C and 1.5–3 amp./cm.^{2} produced a boride layer (12–20 per cent B) with microhardness >2500. A boride layer with microhardness >2200 was also produced on heating Ti-5 per cent Cr alloy in B powder in vacuo at 1000–1150C. X-ray analysis showed that it contained TiB. Alloys VT-1 (forged commercial Ti) and VT-2 (Cr 2.5, Al 2 per cent) were hardened satisfactorily in a fused bath contg. borax 60, B_4C 40 per cent, even at 800C, when grain growth was a min. After 6-hr treatment, H_{vs} increased from 260 to 480 and from 430 to 685, resp., the microhardness from 260 to 680 and from 425 to 810, resp.

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BOSTON BRANCH GOLDEN JUBILEE ANNUAL MAY 2

The announced plans for the Twenty-third Annual Technical Session and Banquet of Boston Branch assure another notable AES Golden Jubilee event. It will be held on Saturday, May 2 at the Hotel Statler-Hilton in Boston. F. Wayne Martin is the chairman.

Librarian George Marotta will present three speakers at the afternoon Technical Session. Edwin F. Ottens of the Philco Corp., Philadelphia, will speak on "Printed Circuit Manufacture"; the paper to be given by Dr. Walter R. Meyer, Enthone, Inc., is titled "Troubles in Finishing of Metals and Their Solution" and Dr. Abraham M. Max, RCA Victor Record Division, has chosen as his subject "Contributions of Plating to High Fidelity Records."

A theatre party has been arranged for the ladies during the afternoon under the chairmanship of Miss Bertha Colokathis, the Branch's only feminine member. The ladies will again view a live stage presentation of a hit production. Entertainment and dancing will follow the banquet. The tickets are $8.50 per person.

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PERSONALS

Donald W. Oakley has been named general manager of the new integrated Coatings Division of Metal & Thermit Corp. in the divisionalization of their organic coatings operations.

Mr. Oakley received his BS and MS in chemical engineering from Columbia University and later attended the Columbia University School of Business. He joined M&T in 1947 and previous to this new appointment was production manager of the manufacturing division. Mr. Oakley is a past chairman of the New Jersey section of the American Institute of Chemical Engineers and presently serves on the national program committee.

D. W. Oakley

A. S. Pollock

D. R. Meserve

F. L. Scott

To assist Mr. Oakley, three other appointments have been made; **D. R. Meserve,** sales manager; **Fremont L. Scott,** technical manager; and **A. S. Pollock,** plant manager.

Mr. Meserve is an alumnus of Middlebury College where he received his BA in Chemical Engineering. He has been with Metal & Thermit for 17 years and held many responsible positions within the company including research and development, technical service, plant manager and until recently product manager of coatings. Since 1957, Mr. Meserve has served as chairman of the Vinyl Dispersions Division for the Society of Plastics Industries. He is a member of the National Association of Corrosion Engineers, the National Paint & Varnish Association, and the American Management Association.

Mr. Scott is a graduate of Boston College where he received his BS and MS in chemical engineering. He came to M&T in 1942 and formerly held the position of research manager. Mr. Scott is an active member of the American Chemical Society, National Association of Corrosion Engineers, the Society of Plastics Industries, the American Society of Testing Materials and the American Electroplaters' Society.

Mr. Pollock received his BS in chemical engineering at Rensselaer, and his MS from Columbia University. He joined M&T in 1955 and was superintendent of organic coatings and process engineering prior to his new appointment. Mr. Pollock is an active member of the Institute of Chemical Engineers.

Flavio J. La Manna recently joined Electrical Industries, Murray Hill, N. J., as electroplating engineer, overseeing the company's expanding finishing department. In this capacity, Mr. La Manna will set plating specifications, solve plating problems, direct the control of solutions, develop plating procedures and advise the production department in matters pertaining to finishing. Electrical Industries is a division of North American Phillips.

Mr. La Manna was formerly chief chemist at Bart Manufacturing Corp., Belleville, N. J., and prior to joining Bart in 1952, he was with the National Yeast Corp. and General Electric Co. He received a BS in Chemistry in 1949 from Seton Hall College and has done graduate work at the Seton Hall. He is an active member of the AES Newark Branch and is the Chairman of the Newark Branch Electroplating Course and secretary of the National Committee on Electroplating Courses.

F. J. La Manna

J. Azzolino

Joe Azzolino has been named technical sales representative for Heatbath Corp. for northern New Jersey and metropolitan New York.

Mr. Azzolino is a graduate of Fairleigh-Dickinson University with a BS in chemistry. He was employed by Wright Aeronautical Division, Curtiss Wright Corp.,

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Woodbridge, N. J., for eight years and held the position of assistant project engineer when he left to join Heatbath.

Mr. Azzolino has had wide experience in plating processes and allied metal finishing operations and is presently a member of the Newark Branch, AES.

He will have his headquarters at 106 Central Ave., Lodi, N. J.

Jerome A. Ryan has been appointed assistant manager of solvent sales, Chlorinated Products Division of Diamond Alkali Co.

At his new post, Mr. Ryan will assist C. W. Wheeler, manager of solvent sales, which include perchlorethylene, carbon tetrachloride, ethylene dichloride, fire extinguisher fluid, chloroform, methyl chloride and methylene chloride.

Mr. Ryan has a background of 15 years' experience in the technical sales service field. He joined Diamond in May 1954.

The new assistant manager is a graduate of the University of Alabama, from which he earned his BS degree in Geology in 1942. He is serving on a committee of teh American Society of Testing Materials.

Thomas Trowbridge is newly appointed as general sales manager of the Behr-Manning Co.'s Coated Abrasive Division. **Thomas G. Gilcoyne** has been appointed field sales manager of the division.

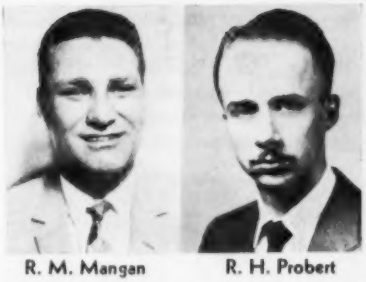
Mr. Trowbridge, a native of New York City, was graduated from New York University. He has been with the Troy firm since 1922, occupying progressively important sales posts in this country and, for two years, in England.

He served for several years as assistant manager and later manager of the firm's product engineering department, was

T. Trowbridge T. G. Gilcoyne

eastern regional sales manager from 1948 to 1954, was made assistant sales manager in 1955 and became sales manager the following year.

Mr. Gilcoyne was graduated from Troy schools and Rensselaer Polytechnic Institute. He has been a member of the sales department since 1937 except for service as a Navy lieutenant during World War II. He has served as New York divisional manager, was manager of general trades sales from 1954 to 1957, and became manager of industrial sales last year.



R. M. Mangan R. H. Probert

Robert M. Mangan has been appointed to head the J. B. Ford Division of Wyandotte Chemicals Corp.'s new mineral absorbents' sales department.

The new absorbent, trade named "Blot", is a diatomaceous earth product.

Robert H. Probert industrial salesman with the J. B. Ford Division of Wyandotte Chemicals, has been transferred from the Miami, Florida area to Greensboro, North Carolina.

Mr. Probert will cover the tri-state territory of North Carolina, South Carolina and Virginia. He has eight years' experience in the plating industry, and is a graduate of Georgia Institute of Technology, from which he holds a degree in industrial management.

Robert Probert is a past vice president and secretary of the AES Southeastern Branch and is now a member of the Blue Ridge Branch.

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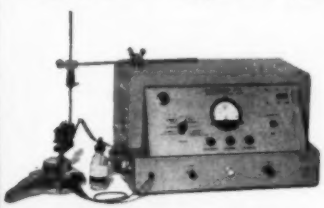

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Donn K. Kauffman has been appointed to the position of plant manager—Plastics Division of The Ceilcote Co. Mr. Kauffman will be responsible for all phases of manufacturing the firm's reinforced plastic ventilating and processing equipment.

D. K. Kauffman

E. Crisenberg

Eugene Crisenbery is now chief engineer of the Arthur H. Losey Co. in Jackson, Mich.

He studied at Jackson Jr. College, and the University of Arizona; and formerly was associated with Industrial Designers, and Hughes Aircraft on guided missile test equipment.

He will be in charge of the designing and manufacture of machinery and fixtures for automatic finishing.

CHARLES THOMAS McGINLEY

Charles Thomas McGinley, a prominent member of the St. Louis Branch, AES, died suddenly Dec. 13, 1958, at the age of 71.

Charley started his plating career at The American Stove Company after graduation from High School. He was employed by Wagner Electric Company from 1920 to 1955 when he retired. After retirement he acted as consultant.

He attended most of the AES conventions and served as Delegate or Alternate from the St. Louis Branch. He served as Branch secretary-treasurer many years. He is survived by his wife.

VINCENT B. ARNOLD

Vincent B. Arnold, 74, president and owner of the Grand River Plating & Manufacturing Co., died on Feb. 25 following a long illness. A native Detroiter, Mr. Arnold was an officer from 1930 to 1948 in the consolidated firm of Grand River Plating, United Platers, Inc., and Auto City Plating Co., all of Detroit; and Metal Finishers of Cleveland. He had been a member of Detroit Branch, AES.

VERNER C. ANDERSON

Verner Anderson, one of the founders of Ardco Incorporated of Chicago, Ill., died Jan. 21, 1959. Andy, as everyone called him, had a wealth of friends. He loved and enjoyed people. He was a member of Chicago Branch, AES.

WILLIAM GAUNT

William Gaunt, of Waterbury, Connecticut died at his home Feb. 22 after a long illness. He was born in Yalesville, and lived in Waterbury most of his life. He was employed as service engineer by the United Chromium, Inc., now part of Metal & Thermit for 27 years prior to his retirement five years ago. He had been a member of AES for many years. He leaves four sons, three daughters, a sister, two brothers, 16 grandchildren and one great-grandchild.

Here are a few lines from a poem by J. M. Hosdowich read at the dinner given in Bill Gaunt's honor when he retired in 1954. The verses relate how he would help a plater who had run into trouble.

With a cool smile and humorous patter,
Bill quietly checked to see what was the matter.

* * *

The cause of the trouble he found and corrected.
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And after the job was running once more,
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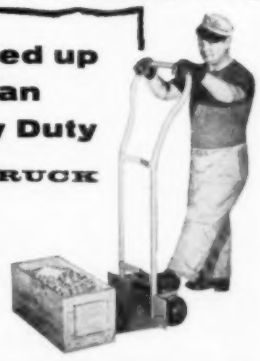

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BRANCH NEWS

Total AES Branches U. S., Canada Australia, March 1, 1959 — 58.

BALTIMORE-WASHINGTON

Pierdon Reports Golden Jubilee Celebration Plans; Dr. Wood Discusses Electrochemical Methods

The regular February meeting of the Baltimore-Washington Branch was held at the Regent House Hotel, Baltimore, Maryland, Tuesday, Feb. 10.

The meeting was called to order by the president, **Carl Thiede. Arthur Pierdon** gave a brief report on the status of the Golden Jubilee Celebration to be held on April 11, 1959 at the Statler Hotel in Washington, D. C. It was announced that the treasurer, **Lancaster Lowry** was confined to the Prince Georges Hospital, Cheverly, Maryland due to a stroke suffered in January.

Edward Roach, the librarian, introduced the speaker of the evening, **Dr. Gwendolyn Wood,** Bureau of Standards, Washington, D. C. and also president of the Baltimore-Washington Branch of the Electrochemical Society. Dr. Wood's subject was "Electrochemical Methods for Producing High-purity Metals from Aqueous Solutions." Dr. Wood had numerous slides shown to tabulate the percentages of purity and impurities in the plated metals. The goal in the work of Dr. Wood and others being metals 99.999 plus per cent pure.

A special meeting of the Board of Managers was held at Allen's Flamingo Restaurant, Laurel, Maryland on Tuesday, Feb. 23.

Harold W. Scott
Secretary

BLUE RIDGE

Pierdon Talks on Plating Shop Operation

The Blue Ridge Branch held its regular monthly meeting Jan. 2 at the Hut Restaurant, Collinsville, Va., with **T. R. Boggess** presiding.

It was decided that since the central meeting place was not working out to improve attendance we would begin alternating meetings in North Carolina and Virginia.

Mr. Boggess introduced **Art Pierdon** of Art Metal Finishing Co. and Baltimore-Washington Branch who spoke on the Subject "Operating a Job Plating Shop."

Art outlined how equipment may be obtained, and the cost of equipping a shop for various kinds of operations. Copies of the National Association of Metal Finishers Cost Survey were passed out and Art explained in detail what the dollar income would be spent for in operations of various sizes. He also pointed out many of the problems, economic and technical, which befall job platers. The talk was followed by an active question period.

Carl Witherspoon
Secretary-Treasurer

BLUE RIDGE

Washburn Speaks at Roanoke Meeting

The Blue Ridge Branch held its regular monthly meeting Feb. 6, at the Carlton Terrace Coffee Shop in Roanoke, Virginia, **T. R. Boggess** presided.

Financial report of the branch was made by Secretary-Treasurer, **Carl Witherspoon.**

Edward Washburn, supervisor of the Technical Service Laboratory of Enthone, Inc., gave an illustrated talk on "Stripping of Electrodeposits." Ed began by outlining why stripping without damaging base metal was desirable. Selective plating, two-tone effects, removing nitriding masking, and reclamation of improperly plated parts. Four types of strippers were described: anodic, salt, caustic, and acid. Formulations and processes for all types of stripping were shown and explained. The lecture was followed by a lively, question period.

Carl Witherspoon
Secretary-Treasurer

BUFFALO

Gessman Speaks on Anodizing

The February meeting of the Buffalo Branch was held Friday, Feb. 6, at the Niagara Manor.

During the business session the various Regional Committee Chairmen reported that all arrangements were completed for the 5th Empire State Regional Meeting. **Paul Conn** announced that the Technical Societies Council of the Niagara Frontier will hold their annual Science Fair April 21–23.

After the business session, **John Donaldson,** our librarian, introduced **Elliott Gessman** of the Olin Mathieson Chemical Corp. who presented a most interesting talk on "Decorative Anodizing of Aluminum."

The April meeting will be dispensed with to concentrate all efforts on the Regional Meeting.

The annual election of officers will be held at the May meeting, Friday, May 1. This will be the last regular meeting of the 1958–1959 season.

Robert E. Lienert
Secretary

CENTRAL MICHIGAN

Plant Safety Presented by Stone

Central Michigan Branch met at the Roosevelt Hotel in Lansing, Michigan on Tuesday evening, Feb. 3. This was a combined dinner and educational meeting. Nineteen members and guests attended in spite of very poor weather conditions.

The speaker for the educational portion of the meeting was **J. R. Stone,** safety director for the Oldsmobile Division of General Motors Corporation. Mr. Stone's talk, "Safety in the Plating Plant," covered not only all the obvious hazards with which most platers are or should be aware but based on some 18 years in the safety field, covered the methods by which equipment manufacturers should build in safe-guards for additional protection. Charts and diagrams pointed out types and frequency of accidents and methods for cutting down or eliminating the hazards.

E. Spraker, Branch member, won a new attendance prize of $10.

Homer E. Welch
Second Vice President and Publicity Chairman

CHICAGO

Safranek Presents Paper on Zinc Die Castings

The February meeting of the Chicago Branch was held on Friday, Feb. 6, at our regular meeting place, the Western Society of Engineers. A new set of bylaws was voted on and accepted by the members present. Four new men were elected to membership of the Branch. "Ladies-Nite" will be held on Saturday, April 11, at the Midwest Country Club in Hinsdale, Illinois. There will be door prizes for the ladies and **Robert Leighton** will present a sound and color film about the island of Sumatra.

After the business session, **Joseph C. Corre,** our librarian, introduced the speaker of the evening, **William H. Safranek** of Battelle Institute, Columbus, Ohio. Mr. Safranek is assistant chief of the Electrochemical Engineering Division at the Institute. His subject was "Better Electroplating for Zinc Die Casting."

BRANCH SECRETARIES

Branch News is required of all Secretaries monthly by AES Bylaws. First of the month is Branch News deadline for next PLATING issue. Any items on hand on that date will be carried in that edition. Later arrivals will appear in the issue immediately following. In reporting talks given by speakers before the Branch, please give titles of the talks, the speakers' full identification and any other pertinent information of interest to other Branches and PLATING's broad readership.

Colored slides were used throughout the talk to illustrate the results of the plated panels subjected to outdoor exposure and accelerated corrosion tests. The Detroit area and Kure beach were used for the outdoor exposure tests. The accelerated corrosion tests included (1) the Corrodkote test which consisted of two 20-hour cycles in humid atmosphere; (2) the 192 hour acetic acid salt spray test and lastly (3) the copper chloride-acetic acid salt spray test.

The test panels were plated with (1) 0.0004 in. of copper (2) 0.0008 in. of nickel and (3) 10 to 80 millionths of chromium. When conventional chromium plate was used, it was observed that corrosion usually began in the nickel plate in the form of pits, due to cracks or pits present in the chromium plate. The corrosion (pitting) continued until the nickel plate was completely penetrated (2) proceeded laterally along the copper interface until the copper is perforated (3) then the die cast corroded rapidly with the formation of blisters. However, when bright crack free chromium was applied a noted increase in corrosion resistance was observed. A thickness of 25 millionths of bright, crack-free chromium was just as good as a deposit of 75 millionths. The chromium plate was plated from a 33 oz/gal of chromic acid with a ratio of chromic acid of 160–170 to 1 of sulfate. The operating temperature was 120–130F, preferably at 130F and the current density 200–300 amp/sq ft. The chrome plate was applied over 0.0004 in. of copper and 0.0008 in. of nickel. The results of tests showed that varying the thickness of the copper-nickel layer was less effective as increasing the thickness of the bright, crack-free chromium layer. The plating systems that were good in outdoor tests were also good in the accelerated corrosion tests.

Mr. Safranek discussed the alkaline electropolishing bath developed for die castings with the intent of eliminating the buffing operation. However, the electropolishing process must be carefully controlled to a depth no greater than 0.001 in. The surface of the casting below this limit is filled with numerous pits and pores and not an ideal surface to cover with the copper-nickel-chromium system. However, when 0.001 in. of zinc plate from an acid zinc plating bath was applied, the porosity was reduced and a noticeable improvement in corrosion resistance was observed.

The blistering that results due to entrapment of plating solution in basis metal surface pits can be helped by using the good pore-filling power of the leveling zinc acid bath. After the question and answer period, Mr. Safranek received a rising vote of thanks for his very informative talk.

Christopher Marzano
Publicity Chairman

CINCINNATI

Strow Discusses Stripping of Coatings

The meeting was called to order by President **Helmich** with 39 members and guests present. One application for membership was approved.

The president appointed **Will Loveless** as chairman of the Nominating Committee, with **Francis Fuller** and **Bill Young** to assist.

Ezra Blount reported on the Interim Meeting at Atlanta and pointed out the two main items were the nomination of **Art Pierdon** as 3rd vice president and the resolution to raise the dues $5.00 per year.

Henry Strow, of the Trubrite Chemicals Co., spoke on the "Stripping of Metallic Coatings." The discussion covered the stripping of cadmium, zinc, tin, chromium, copper, and great emphasis on nickel. Mr. Strow gave a complete discussion on the mechanism of the stripping action of nickel and the various basic baths which are available.

After a question and answer period the

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group adjourned to the Social Hour sponsored by the Metal and Thermit Corp., **Elmer Rehme** as host.

David L. Kaplan
Secretary

DAYTON

Talks by Fisher on Polarography and Pettit on Metal Etching

A regular monthly meeting of the Dayton Branch was held Feb. 18, 1959 at the Biltmore Hotel. **Bennie Cohen** announced the final arrangements for the Branch's Thirteenth Annual Educational Session and Dinner Dance on March 7. Two new members were received.

Robert Fisher of National Cash Register Company gave a short explanation of Polarography and its application in the control of plating solutions.

Ralph Pettit, technical advisor, Diversey Corp., Chicago, Illinois gave an interesting talk on "Etched Metal Goods." He discussed both deep etching such as chemical milling and decorative etching and subsequent processing connected with the manufacture of aluminum name plates and similar parts. His talk was illustrated with beautifully made color slides.

Refreshments following the meeting were provided by Diversey Corp. through their local representative **L. R. "Tex" Lindsey.**

L. A. Critchfield
Publicity Chairman

DETROIT

Dr. Brown Discusses Corrosion; McAleer Reports Favorably on Exposition

The Detroit Branch had an executive group meeting Friday, Feb. 6, prior to the monthly Branch meeting. In attendance at the executive meeting were the following: **Manuel Ben,** president; **Edward J. Kubis,** secretary-treasurer; **Guy Cummings,** board of managers; **J. Doug Thomas,** board of managers; **Henry Brown,** speaker; **Vince Cassidy,** educational chairman; **Howard McAleer,** exposition chairman; **John Siefen,** board of managers; **Lee Morse,** alternate delegate; **Cleve Nixon,** delegate; **Joe Gurski,** alternate delegate; **Bob Trees,** publicity chairman; **John Hitchcock,** ass't secretary-treasurer; **Glen Friedt,** past president; **Wright Wilson,** convention chairman; **Fred Olmstead,** 2nd vice president.

The executive meeting started at 7:15 following dinner. Mr. Ben announced the appointment of **Clarence DeGroat** as head teller for the nomination of the Branch officers

Ed Kubis announced the death of an old time Detroit Branch member, **N. L. Goodwin,** of Windsor, Ontario. The Branch sent a donation to Mr. Goodwin's favorite charity as a token of friendship for him.

Guy Cummings reported for the Board

Dr. Henry Brown Manuel Ben

of Managers, particularly in regard to the election of honorary members calling attention to the lack of a definite regulation concerning the election of such members and the need for a clarification and strengthening of the Branch Bylaws on that subject. In a motion by Cleve Nixon it was decided that the president should appoint a committee to study the honorary membership Bylaws and suggest changes.

Vincent Cassidy reported on the Educational activities and suggested that a method be set up to insure a carry over of interest in the handling of programs, possibly the election of a co-chairman—one each year for a period of two years.

Mr. Friedt reported on Research calling attention to the loss of two members and asking for suggestions on replacements.

Howard McAleer reported on the 1959 Industrial Finishing Exposition reporting total space sold as of Jan. 31, 27,595 square feet of the 34,675 square feet available. The total exhibitors to date are 130. Mr. McAleer called attention to the fact that this 5th Industrial Finishing Exposition has already out sold every AES Exposition to date. He also reported that statements of the balances due on the contract for space were being mailed immediately as full payment is required by March 1.

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Wright Wilson reported that the Editorial Board accepted the Convention Program detailed by **Walter Pinner**.

Cleve Nixon reported on the Long Range Planning Committee. Mr. Nixon called attention to a number of items of discussion and the suggestion for possible changes in meeting agenda coming from these discussions.

The Detroit Branch meeting under the guidance of Vincent Cassidy as technical chairman was held in the Michigan Room of the Statler Hotel at 8 p.m. on Feb. 6th. The speaker was **Dr. Henry Brown,** director of research of The Udylite Research Corporation. He spoke on the subject, "Corrosion Studies of Various Combinations of Nickel and Chromium." This meeting was unusually well attended, approximately 180 members and guests heard Dr. Brown's timely discussion of this important subject.

The meeting notice called attention to the fact that 5 new members had been elected, bringing the total of the Detroit Branch membership to 687.

The next meeting will be held on March 6 and will be Ladies Night.

R. C. Trees
Publicity Chairman

HARTFORD
Carroll Talks on Preparation of Metals

The regular Branch meeting was held at the Hotel Bond Feb. 16, and 50 members and guests were present.

Preceding the meeting a movie in color entitled "How to Get a Good Night's Sleep" was shown through the courtesy of the Sealy Mattress Co.

The guest speaker for the evening was **Walter Carroll** of the Pennsalt Corp., whose subject was "Preparation of Metals for Plating and Painting."

Mr. Carroll gave a brief description of most methods used in the plant today for preparing metals before plating and painting. Slides were shown illustrating how an alkaline cleaner removes oil from a metal surface by shrinking the oil film until the adhesion is completely broken. Precleaning methods of buffed parts by a soak and spray is recommended prior to electrocleaning. Emulsion cleaning is good but carry over into other baths must be avoided. Chelating and sequestering agents formerly used in hard water have been found to assist in soil removal and keeps the fines in suspension. Use of ultrasonic cleaning for the removal of smuts is a recommended procedure. Acid cleaning with and without inhibitors was covered as also alkaline derusting methods. Phosphates prior to painting to increase the bond was briefly mentioned.

The technical chairman for the evening was **Armand Faucher.**

Stanley Platoz
Secretary

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HOUSTON
Dr. Wesley Discusses Industrial Nickel Plating Applications

The regular February meeting of the Houston Branch was called to order by our President **Buster Dunaway** on Tuesday, Feb. 17. The Nominating Committee consisting of **Roy Byerley,** chairman, **Dale Chapman**, and **Harold Bartay** was appointed. The meeting was held at the Ram's Club for the first time and all members present agreed that this was an excellent meeting place and voted to return next month.

Dr. W. Andrew Wesley of the International Nickel Co. spoke on "Industrial Nickel Plating and Applications of Industrial Nickel" in the lecture.

The Houston Branch was honored to have the National Second Vice President speak at the meeting and enjoyed hearing him talk about the Southern Regional Meeting recently attended in Atlanta.

Harry Van Wagner
Secretary-Treasurer

INDIANAPOLIS
Scharver Discusses Flame Spraying; Ladies Night Voted

Forty-one members and guests of the Indianapolis Branch met at Fox's Steakhouse on Feb. 2, 1959, for the monthly meeting. Following the usual introduction of members and guests, **Paul Johnson,** Branch librarian, introduced the speaker of the evening, **Mr. Scharver** of Linde Air, who discussed the New Developments in Flame Plating. He explained the various types of guns and torches used to obtain the high velocities and temperatures for the plating on of such refractory materials as tungsten carbide, chrome carbide and aluminum oxide. By flame plating, these materials can be built up at a high rate of deposition, and that even though the gun temperatures are high, the work temperatures never exceed 400°.

The bond of such materials to the base metal is very good, even though it is a mechanical bond, what they term a molecular weld.

Following the discussion period, the business meeting was opened by Branch President **John Hood.** The application of a new member was received and accepted on a motion by **Quentin Shockley** and a second by **Herb Kennedy.**

Mr. Shockley reported on the status of the Bylaws for the Tri-State. He stated that he did not feel that any great changes are necessary. Copies of the present Bylaws were distributed to the Board of Managers and others who wished them. Any proposals for amendment will be discussed at the March meeting.

Les Reynolds reported on the Tri State Regional ticket sale for the April 4 meeting in Louisville. Tickets are available from him, and March 27 is the deadline.

Roman Bender expressed his appreciation for the floral piece sent to his father.

Bert Hawhee was elected Branch junior member to the Tri State Region. There was a motion by Bert Hawhee that a Ladies Night meeting be held in Anderson either in April or May. It was seconded and passed. The date will be set when final arrangements are completed for a speaker.

A. M. Howard
Secretary

MONTREAL

Blount Explains Electroplating Course

Regular monthly meeting of the Montreal Branch was held at the Sheraton-Mount Royal Hotel on Feb. 2.

The meeting was called to order by First Vice President **D. Takeuchi,** with 20 members present.

Mr. Takeuchi called upon **P. M. Coady** to introduce **Ezra A. Blount,** editor of *Products Finishing.* Mr. Blount gave a very interesting talk on planning and running an Electroplating Course. This talk proved very helpful because the Montreal Branch have just started an Electroplating course. Mr. Blount was thanked on behalf of the Montreal Branch by **J. Saimoto.**

R. W. Niggemann
Secretary-Treasurer

NEWARK

Bockris and Rinker Present Papers; Class Graduates

Over a hundred braved one of the coldest nights of the year to attend the meeting of Newark Branch. **Gus Bittrich** introduced **Tom Haddow** an original AESer and early Newark Branch member. **John Banta** reported on Ladies Night urging attendance. **Don Foulke** reported five applications for membership. Four men were elected to membership. **Robert Ehrhardt,** reporting for the Nominating Committee, presented a slate of officers. Cy La Manna presented diplomas to 26 graduates of the electroplating course and announced seven had been unable to attend, but had passed the course.

Librarian **Korbelak** then introduced **Ed Rinker** of Sel-Rex Precious Metals who discussed crack-free, low-stress platinum. Ed explained the research in precious metals and described two new baths developed to provide 1) bright and 2) low-stress, ductile deposits. Mr. Rinker noted certain applications where such deposits would be useful.

Dr. J. O'M. Bockris of the University of Pennsylvania and Project Director of AES Project No. 16 then discussed the Mechanism of Electrodeposition in his usual excellent manner. He described the three fields of knowledge needing exploration. Learn to know: 1) What the particles in solution are, 2) what is next to the electrode, 3) the electrode "itself," i.e. how deposition occurs.

Dr. Bockris discussed each of these to explain complexes in solution and salvation of ions, the electro-double layer and the mechanism whereby metal atoms slide over the electrode surface into position.

D. Gardner Foulke
Secretary

NEW YORK

Danek Speaks on Waste Disposal

The President, **Dr. Edward B. Saubestre,** called the Jan. 23 "open" meeting at the Hotel Statler to order.

A candidate for membership was accepted by the Branch and was duly sworn by the president.

In a letter received by **Milton Nadel,** it was disclosed that we have "four" and not three surviving charter members. **Edward W. Faint** authored the letter, and it is he who rounds out the foursome. He is now a member of the Newark Branch, but says he is too old to attend functions of the AES.

Joe Rembecki, banquet committee chairman, thanked all the members of his committees for their share in preparing for the 50th Anniversary celebration. This affair promises to be the most gala event ever held by the New York Branch.

Arthur Carlson, librarian, was called on to conduct the Good and Welfare portion of the meeting. Artie introduced us to **L. R. Danek** of the "Industrial Filter Co." Mr. Danek described the latest methods of waste disposal in plating rooms. Disposal of plating room wastes is a fast growing problem. In many cases the government has already insisted on thorough treatment of rinse waters prior to disposal. So important is this topic that Mr. Danek was confronted with queries from the floor while he was delivering his paper. This reaction by the audience proved that the topic was a timely one. The speaker received a rising vote of thanks.

Anthony P. Briganti
Recording Secretary

PHILADELPHIA

Squitero Talks on Nickel Plating; Cogan Reports Interim Meeting

The regular meeting of the Philadelphia Branch was held Feb. 23 at the Engineers Club; 24 were at dinner—60 at the meeting. Guests were introduced; the minutes of the previous meeting were read; the treasurer gave his report; eight active

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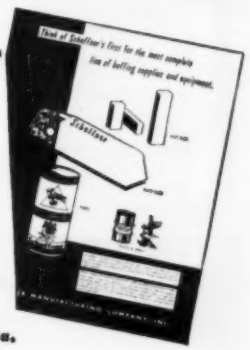

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members were admitted and two applications were received. First Vice President and Delegate **James Cogan** reported on the Interim Meeting held in Atlanta.

The speaker was **A. Squitero,** chief chemist, Hanson-Van Winkle-Munning Co., substituting for **H. G. Zucker,** who was ill. Mr. Squitero spoke on "Nickel Plating for Engineering Application." With the aid of slides, he described the constituents, operating conditions and applications of the following non-decorative nickel plating solutions: Watts low *p*H; Wesley and Roehl hard nickel; Wesley and Carey all chloride; 1 per cent cobalt-nickel bath; fluoborate; sulfamate —Barrett; Diggin.

I. Wm. Marcovitch
Secretary

PITTSBURGH
Saltonstall Presents Agitation in Electroplating

The second meeting of 1959 was held, as usual, at the Gateway Plaza, Downtown Pittsburgh.

The Ladies' Auxiliary had dinner with the men, after which they departed to be entertained by "Feats of Magic" performed by our own **Rex Goldbach.** After the show, praise from the ladies was voluminous.

E. I. Smith presented for 1959-1960, on behalf of the nominating committee, the following officer nominations: President, **Stevens Pizoli;** first vice-president, **McHattie Woehrle;** second vice president, **Burford Forbes;** secretary, **E. B. Keller;** treasurer, **Kost Bugel;** librarian, **Benro Sellger.**

Librarian **C. A. Forbes** introduced **Dr. Richard B. Saltonstall** of Udylite Corp. His topic was "Roll of Agitation in Electroplating."

E. B. Keller
Secretary

ROCHESTER
Sonnenfeldt Compares U. S. and European Plating

The Feb. 2 meeting of the Rochester Branch was held at the Rochester German Club. The meeting was called to order by President **Frank Beuckman.**

Business matters discussed were: The Board of Managers have suggested that a local Branch Member will be asked to give a short presentation at regular meetings to supplement the regular speakers for the evening. A plant visit to Oneida Limited at Sherrill, New York has been suggested and cards sent out to see how many members are interested in such a visit.

The speaker of the evening was introduced by Librarian **Ed Penczek. Rene Sonnenfeldt,** sales engineer for the Sel-Rex Corp., compared European plating practices to United States practices from pickling to plating. Having worked or visited in many European plating facilities, his information was first hand and there is little doubt but that he covered his subject better than anyone else in the United States could have done. His talk was very well accepted by the Rochester Branch members present at this meeting.

Linwood P. Morrison
Secretary-Treasurer

ST. LOUIS
Panel on Cleaning and Pickling

The regular monthly dinner meeting of the St. Louis Branch was held Wednesday night, Feb. 11 at the York Hotel. Possibly the attendance was poor due to it being Ash Wednesday; in any event a very interesting meeting followed the dinner. The business meeting was called to order by our president, **William George.** Four new members were accepted into the society on a motion by **Andy Julius** and a second by **Ruel Shumway** that passed without opposition.

Our chairman mentioned that the secretary had a few AES pins for sale to the members who might be interested.

Andy Julius reported the results of the Midwest Regional meeting which he attended in Chicago. He mentioned that **Les Diveley** asked him to serve on the Milwaukee convention advisory committee and furnish names of others from the St. Louis Branch who would be willing to serve in other capacities. With the permission of the members, Andy is to contact ten members who will serve. President George also attended this meeting and he commented that he was principally impressed by what the St. Louis branch stands to gain but felt that it was for the betterment of the entire organization.

The meeting at this point was turned over to Librarian **Arthur Wrisberg** who told us that the April meeting would be a talk by **Russel Vandenberg** of Alcoa with a movie on anodizing. The tentative arrangements for March are for a talk on stripping. He then introduced a panel of four St. Louis Branch prominent members who served on a panel to discuss Cleaning and Pickling of Steel and Zinc Base die Castings. The panel consisted of: **Louis Berra,** president, Sinclair Industries; **John Vogt,** superintendent of finishing, Knapp Monarch Co.; William George, superintendent of finishing, National Rejectors Co.; and Andy Julius, superintendent of finishing, C. Hager and Sons Hinge Mfg. Co.

Lou related how, about ten years ago, he discovered double cleaning was the only way he could plate wire goods. John Vogt told how the buffed steel parts they manufacture are run through a three stage degreaser, and a subsequent wiping operation is necessary before going through the electric cleaner. Bill George gave the cycle used at National Rejectors for cleaning zinc base die castings prior to nickel and chrome plating. Andy Julius related

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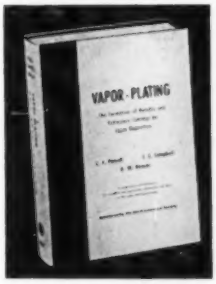

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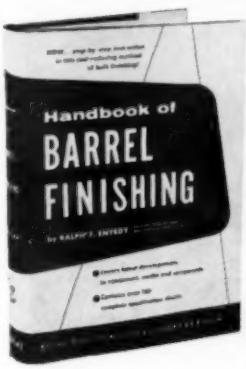

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how he completely eliminated the acid pickle from the automatics used for brass and cadmium plating hinges. It was an interesting meeting as indicated by the many questions.

Ward Kelly
Secretary

SOUTHERN TIER
Gehmann Discusses Conversion Coatings

Our regular Jan. monthly meeting was held at the Langweel Hotel, Elmira, N. Y. A small number of members attended due to inclement weather. The financial report on the Christmas Party was quite favorable and all those present gave a full round of applause to the Christmas Party chairman, **Mr. Rood** for a well planned evening.

Member **S. Stefanski** reported on a meeting he attended at Rochester, N. Y. recently where he obtained information concerning organization of the Empire State Regional meetings. A Board of Managers meeting was called by President **Morgan Rake** to discuss the 1960 Regional meeting.

Librarian **Charles Emery,** introduced the evening's speaker **Hugh Gehmann,** representing the Amchem Co. His topic for the evening was "Conversion Coatings as Applied to the Cold Deformation of Metals." The function of the conversion coating on the metal prior to forming is 1) Hold the lubricant, 2) Provide a barrier between tool and work. Inorganic film (phosphate) does not char under pressure, however organic film such as drawing compounds do char under pressure. Phosphate coating steel prior to forming reduces die cost and results in higher quality work. Along with these two advantages, of course, goes along a higher production rate in same amount of time and reduction of reject parts.

Phosphate coating of steel prior to forming is most popular on tubing or wire. Materials have also been developed for a conversion coating on stainless steels. A question and answer period followed this fine talk. Next month's meeting to be held in the Binghamton area.

B. Rossiter
Secretary

SOUTHERN TIER
Rectifiers Discussed by Norcross

Our Feb. monthly meeting found a new meeting place, Lou's Grill, Johnson City, N. Y. Approximately 28 members and guests attended a fine dinner and meeting. Among the guests present were: **Don Blum, Al Duggett** from the Rochester Branch, **Mr. Jeffries,** also **Messrs. Bassage** and **Press** from Ingersoll Rand Inc. and a **F. Mix** from I.B.M. Corp.

President **Morgan Rake** opened the meeting with an urgent call to all members to be on hand at the Empire State Regional meeting in April at Buffalo, N. Y. Member **Stan Stefanski** informed those present of the coming events to take place at this year's regional meeting.

President Rake introduced the evening's speaker **Charles Norcross** representing the Ther Electric and Machine Works, Chicago. Mr. Norcross spoke on the "History of Rectifiers" as used in plating departments. He gave a complete analysis of the different elements used in rectifiers, their advantages and disadvantages, bringing us up to the more modern silicon rectifiers.

A short question and answer period followed Mr. Norcross' talk.

Our next meeting is to be held at the Langwell Hotel in Elmira, N. Y.

W. Rossiter
Secretary

SYRACUSE
Dr. Max Speaks on Electroplating Applications for Records

On Feb. 16 the Syracuse Branch held its monthly meeting at Turners' Hall, 619 North Salina Street, Syracuse. Dinner was held at 6:30 p.m. and the technical session followed at 8:00.

The speaker for the evening was **Dr. A. M. Max,** development engineer, R. C. A. Victor Record Division, Indianapolis, Indiana. Dr. Max's subject was "The Contributions of Electroplating to High Fidelity Records." He preceded his talk with a colored film produced by R. C. A. on the making of high fidelity records. The film covered all the steps in the processes starting with the first recording on tape in the recording session to the finished product leaving the shipping department. The film was all inclusive and covered all the steps in detail. Dr. Max enlarged upon the problems involved and the special applications of the copper and nickel electroplating involved in record making.

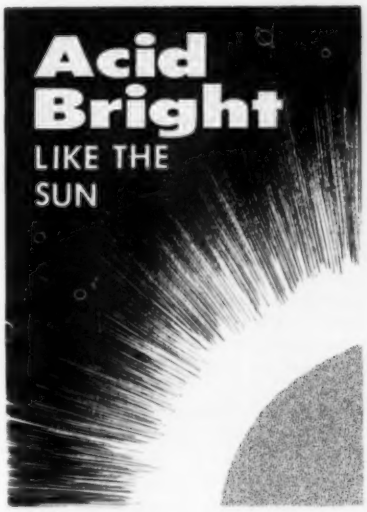
Following the technical session, refreshments were provided by the Udylite Corp. through the courtesy of **Ty Moffatt,** the local representative.

Edward D. Hall
Recording Secretary

TORONTO
Aluminum Finishing Presented by Loucks; Plan Sustaining Membership Drive

The February meeting was held in Toronto on Friday the 13th, in the Manitoba Room of the Royal York Hotel. The new wing is now open and the dining rooms depict the culture and characteristics of the Canadian Provinces; these are well worth the time to come down and browse around between setting up for the meeting. We had 28 attend dinner and 45 for the meeting. **Bob Edward** was in the chair; two new members were introduced.

Herb Skelton of International Nickel has accepted the chair of the Sustaining Membership Committee for the Toronto Branch, and with the able assistance of



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INDICATE A 454.

Kergan Wells, Cy Short and **Art Wilson** is laying plans for a drive to increase this worthy project. I am sure all members in this area can help Herb double the membership to enable our Research Projects to be enlarged and thereby help all of us do a better plating job. On this our Fiftieth Anniversary lets make our individual managers conscious of the work being done by the American Electroplaters' Society in this field.

J. Loucks of the Aluminium Co. of Canada, spoke on "Finishing of Aluminum." **Jim Vaughan** introduced the speaker, whose talk was very interesting. The question period informative and entertaining proved to the listeners that "This man has showmanship."

Montreal, Western Ontario, Hamilton, Buffalo, Rochester, please note: The Annual Regional Meeting of the Toronto Branch will be held May 2 in the General Brock Hotel, Niagara Falls. The Education Program under the guidance of **Al Adams** and **Jim Vaughan** should be of interest to all. For the ladies a fashion show under the direction of Mrs. R. Edwards. Dinner and dancing in the evening, fun and prizes for all. Make your reservations early.

A. W. Wilson
Librarian

WATERBURY
Valentine Social Takes Place of Business Meeting

The Waterbury Branch dispensed with its February business meeting and held its annual social at the Chase Country Club on Feb. 14. A fine steak dinner was preceded by a Branch sponsored cocktail party. Dancing and entertainment occupied the remainder of the evening. Approximately 100 members and guests attended.

F. A. Schneiders
Publicity

WESTERN ONTARIO
Bellinger Speaks on Conversion Coatings

Our February meeting opened with a business session. A fair number of guests and members were present. **Dave Mainland,** our president, had **Bob Dobson,** secretary, read the minutes of our last regular meeting. Vice President **Leo Horodyski** gave a report on the outcome of our "Ladies Night." Even though we went in the hole the members voted the party a success.

Jim Kelly, our librarian, introduced **Ken. P. Bellinger** of Conversion Chemicals, Rockville, Conn. who gave us an illustrated talk on Chromate Conversion Coatings. It was very interesting and was well received by the audience. A short question and answer period followed. **John McKay** thanked the speaker. Refreshments and a few friendly games followed to close an interesting evening.

Leo Horodyski
Vice President

TECHNICAL PROCEEDINGS AWAITING YOUR ORDER

CONTAINING each of the technical papers delivered before the AES's 45th Annual Convention held in Cincinnati, Ohio, May 19-22, 1958, together with their charts, diagrams, graphs, tables and other illustrations, and with the verbatim discussion that followed their delivery, TECHNICAL PROCEEDINGS (1958 Edition) broadly enriches technical and scientific knowledge in the field of electroplating, metal finishing and allied arts.

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A larger book than the 1957 edition, it also carries a front section that includes a complete chronological list of AES Conventions and Past Presidents; a day-to-day log of the 45th Annual Convention; a section on the AES Scientific Achievement Award and on the Paper Awards presented at that convention; a full listing of AES's 1958-1959 Boards and Standing and Special Committees and a complete Branch Directory up to date as at September 1, 1958.

The domestic price of the 1958 Edition of TECHNICAL PROCEEDINGS is $12 per copy including postage. To those ordering from outside of the United States' continental limits, the charge is $15 per copy including postage. All orders must be accompanied by payment in full. Address orders and make checks payable to:

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A limited quantity also exists of the 1956 book at $19.50 per copy domestic; $15 per copy foreign and of the 1957 book at $10 per copy domestic and $12.50 per copy foreign. All orders must be accompanied by payment in full.

NEW ENGLAND REGIONAL GOLD RUSH OF '59

The Twentieth Annual New England Regional Meeting is presenting a "glittering program" at the Hotel Statler, Hartford, Connecticut on Saturday, April 18 to celebrate the AES Golden Jubilee year. New England says, "Join us in the Gold Rush of '59." The program will offer "Golden Nuggets" of wisdom, "Golden Moments" of fun, feasting from the "Golden Horn of Plenty" and dancing to "Golden Music." Waterbury is Host Branch this year. Edward Garland is the general chairman.

The afternoon Technical Session begins at two o'clock. Dr. Abner Brenner of the National Bureau of Standards will talk on "Impressions of Russian Plating Techniques" gained from his trip to the USSR last May. Dr. Edward B. Saubestre, assistant to the research director of Enthone, Inc., will present a paper on "Electropolishing." Michael Tamas is educational chairman.

While the men are attending the educational meeting, the ladies will play bingo, with Bob Boulay acting as master of ceremonies. In charge of entertainment are Mr. and Mrs. Charles A. Kuster. The hostesses are: Mrs. Henry Strow and Mrs. Frank Tirendi, Waterbury; Mrs. Arnold Johnson and Mrs. Walter Dyber, Hartford; Mrs. Charles Griffin Jr. and Mrs. Edward Koetsch Jr., Springfield; Mrs. Michael Tamas and Mrs. Al Ferguson, Bridgeport; Mrs. George O'Conner Jr. and Mrs. Harry Taylor, New Haven.

Cocktail time is from 4:30 to 6:30 p.m., in the Hospitality Rooms, followed by dinner at the latter hour. Dancing will continue until 1 a.m.

Tickets at $6 per person can be obtained from Albert G. Griffith, 94 Ridgeview Place, Cheshire, Conn.

AES MEMBERSHIP REPORT

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San Francisco: M. Raskin from Los Angeles
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Toledo: K. E. Froehe from Cleveland
Waterbury: C. Oates from Syracuse
Member-at-Large: E. A. Walters to Dayton

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TECHNICAL EXECUTIVE—Chemical Engineer with 17 years background in metal cleaning, aluminum finishing, phosphatizing, and finishing equipment. Experience includes product development, manufacturing, technical service, sales promotion, direct and missionary sales, and product management. Well qualified for administrative position in any of these fields. Prefer central or eastern states location. Reply to Box A1, PLATING, 445 Broad St., Newark 2, N. J.

PLATING FOREMAN—Age 31, 11 years of progressive diversified job shop plating experience, which includes make-up, working and maintaining most solutions, still and barrel, anodizing, burnishing and deburring, black oxide treatments on all metals, plating on aluminum, phosphating, Dow 1 and Dow 7 treatments on magnesium, production plating of Cu.-Ni.-Cr. on Die Cast parts. Experienced on government specifications, plating thickness control, troubleshooting. Successful in plating odd difficult jobs. Seek position with future in N. Y. C., Long Island area. Reply to Box A2, PLATING, 445 Broad St., Newark 2, N. J.

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PLATING SUPERINTENDENT—22 years experience, covering strip steel plating, electropolishing, hard chrome, gold and common metals plating. Age 42. 2 years college credit in Chemical Engineering. Some time study experience. Past 8 years as superintendent. Prefer relocation on West Coast. Reply to Box A4, PLATING, 445 Broad St., Newark 2, N. J.

METAL FINISHING ENGINEER—Age 31, BS Chemical Engineering. 9 years research, technical service, process engineering, product development, chromium chemicals for corrosion control, waste and water treatment, anodizing, chromium plating, metal surface treatments. Will relocate, preferably in the New England or Middle Atlantic area. Reply to Box A5, PLATING, 445 Broad St., Newark 2, N. J.

PLATING FOREMAN—Age 31, 12 years experience in Hollow Ware and Job Plating in Silver, Gold, Brass, Copper, Nickel and Chrome. Can maintain own solutions. Seek position with future in New York area. Salary open. Reply to Box A6, PLATING, 445 Broad St., Newark 2, N. J.

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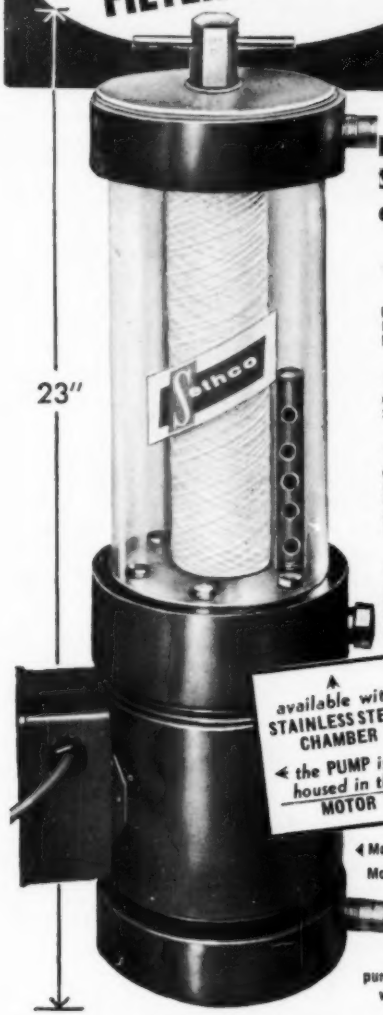

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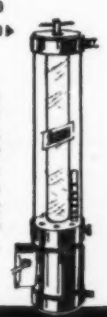

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FUTURE MEETINGS

AMERICAN ELECTROPLATERS' SOCIETY

April 10,	1959—**Executive Board,** Statler Hotel, Washington, D. C.
April 11,	1959—**Baltimore-Washington Branch,** Golden Jubilee Banquet and Dance, and "Order of Past Presidents" Award Ceremony, Statler Hotel, Washington, D. C.
April 11,	1959—**Fifth Annual Empire State Regional,** Buffalo Host Branch, Hotel Peter Stuyvesant, Buffalo, N. Y.
April 18,	1959—**Twentieth New England Regional,** Waterbury Host Branch, Hotel Statler, Hartford, Conn.
April 25,	1959—**Milwaukee Branch,** Annual Meeting and Banquet, Schroeder Hotel, Milwaukee, Wis.
April 29,	1959—**Research Committee,** Hotel Statler-Hilton, Detroit, Mich.
May 2,	1959—**Boston Branch,** 23rd Annual Technical Session and Banquet, Hotel Statler, Boston, Mass.
May 2,	1959—**St. Louis Branch,** Annual Banquet and Dance, Chase Hotel Starlite Roof, St. Louis, Mo.
May 5,	1959—**Central Michigan Branch,** Annual Ladies Night Party, Hotel Hayes, Jackson, Mich.
May 16,	1959—**Providence-Attleboro Branch,** Seminar "Precious Metal Finishing." Old Rhode Island College of Education Building; Banquet, University Club, Providence, R. I.
June 15-19,	1959—**Golden Jubilee Convention and Industrial Finishing Exposition, Including Fifth International Conference on Electrodeposition and Metal Finishing,** Convention Headquarters—Hotels Statler-Hilton and Sheraton-Cadillac, Detroit, Mich. Exposition—Artillery Armory, Oak Park, Mich.
August 22,	1959—**Detroit Branch Stag Day,** Detroit, Mich.
January 15-16,	1960—**Second Annual Dixie Regional Technical Session,** Saxony Hotel, Miami Beach, Florida. Sponsored by Miami Branch with Blue Ridge and Southeastern participating.
April 29-30,	1960—**Sixth Empire State Regional,** Southern Tier Host Branch, Mark Twain Hotel, Elmira, N. Y.
July 10-14,	1960—**47th AES Annual Convention,** Hotel Statler, Los Angeles, Calif.
June 18-23,	1961—**48th AES Annual Convention,** Hotel Statler, Boston, Mass.
June 25-28,	1962—**49th AES Annual Convention,** Schroeder Hotel, Milwaukee, Wis. Sponsorship Midwest Regional Council.
June 24-27,	1963—**50th AES Annual Convention,** Ambassador Hotel, Atlantic City, N. J. Sponsorship Newark Branch.

INTERSOCIETY

May 3-7, 1959—The Electrochemical Society, Spring Meeting, Sheraton Hotel, Philadelphia, Pa.

May 5-7, 1959—14th Purdue Industrial Waste Conference, Purdue Memorial Union Building, Purdue University, Lafayette, Indiana

May 7, 1959—Society of Plastic Engineers, Regional Technical Conference. "Plastics and the Metals Industry," Penn-Sheraton Hotel, Pittsburgh, Pa.

May 16, 1959—Masters' Electro-Plating Association of New York, 41st Annual Banquet, Hotel Plaza, New York.

May 25-28, 1959—ASME Design Engineering Conference and Show, Convention Hall, Philadelphia, Pa.

June 14-16, 1959—National Assn. of Metal Finishers, Annual Membership Meeting, Hotel Statler-Hilton, Detroit.

June 15-16, 1959—National Association of Metal Finishers, Management Seminar, Hotel Statler-Hilton, Detroit.

June 21-26, 1959—American Society for Testing Materials, 62nd Annual Meeting, Hotel Chalfonte-Haddon Hall, Atlantic City, N. J.

May 18-20, 1959—Instrument Society of America, 5th National Symposium on Instrument Methods of Analysis, Shamrock-Hilton Hotel, Houston, Texas.

September 21-25, 1959—Instrument Society of America, 14th Annual Instrument-Automation Conference and Exhibit, International Amphitheater, Chicago.

October 11-16, 1959—American Society for Testing Materials, Pacific Area National Meeting (with Exhibit), Sheraton-Palace Hotel, San Francisco, Calif.

October 18-22, 1959—The Electrochemical Society, Fall Meeting, Deshler-Hilton Hotel, Columbus, Ohio.

November 5-7, 1959—American Chemical Society, Southeastern Regional Meeting, Symposium on Corrosion of Iron and Tin, Hotel John Marshall, Richmond, Virginia.

July 10-12, 1960—National Association of Metal Finishers, 5th Anniversary and Membership Meeting, Hotel Statler, Los Angeles, California.

July 11-12, 1960—National Association of Metal Finishers, 5th Anniversary Management Seminar, Hotel Statler, Los Angeles, California.

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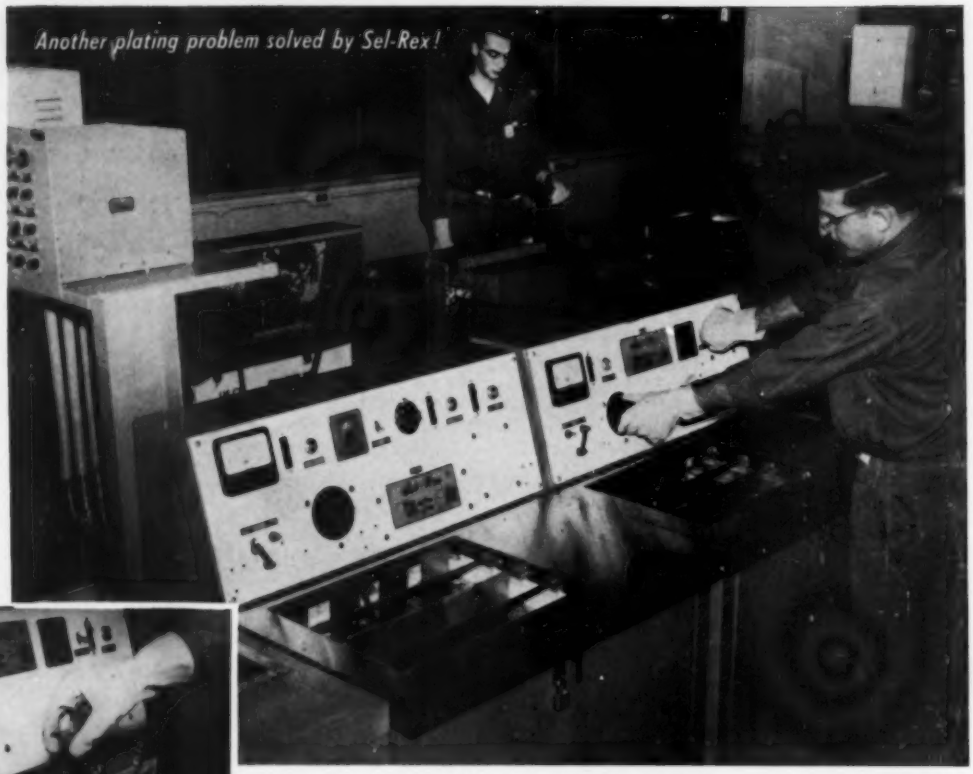

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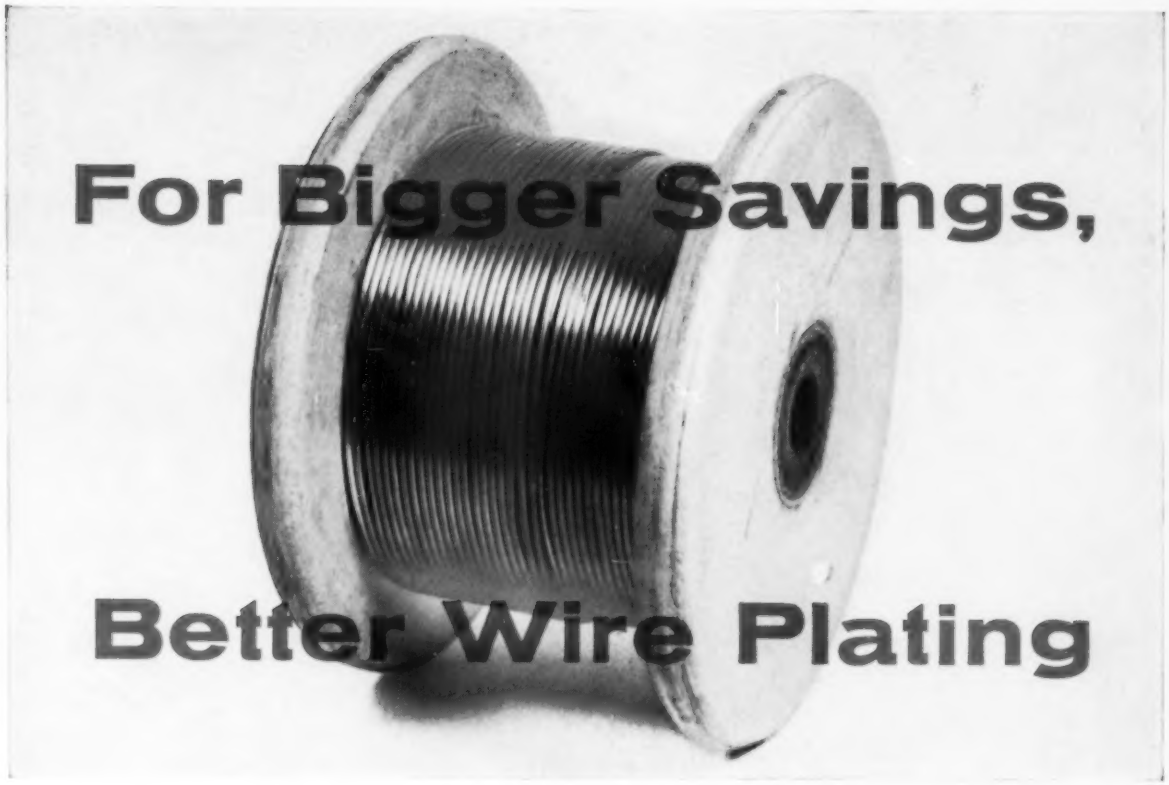

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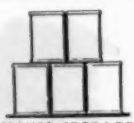

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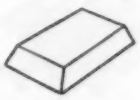

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